

PC
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Portable Computing Blockbuster

- Portable Printers
- Multimedia to Go
- Connections from the Road



NETWORK
EDITION

MAGAZINE

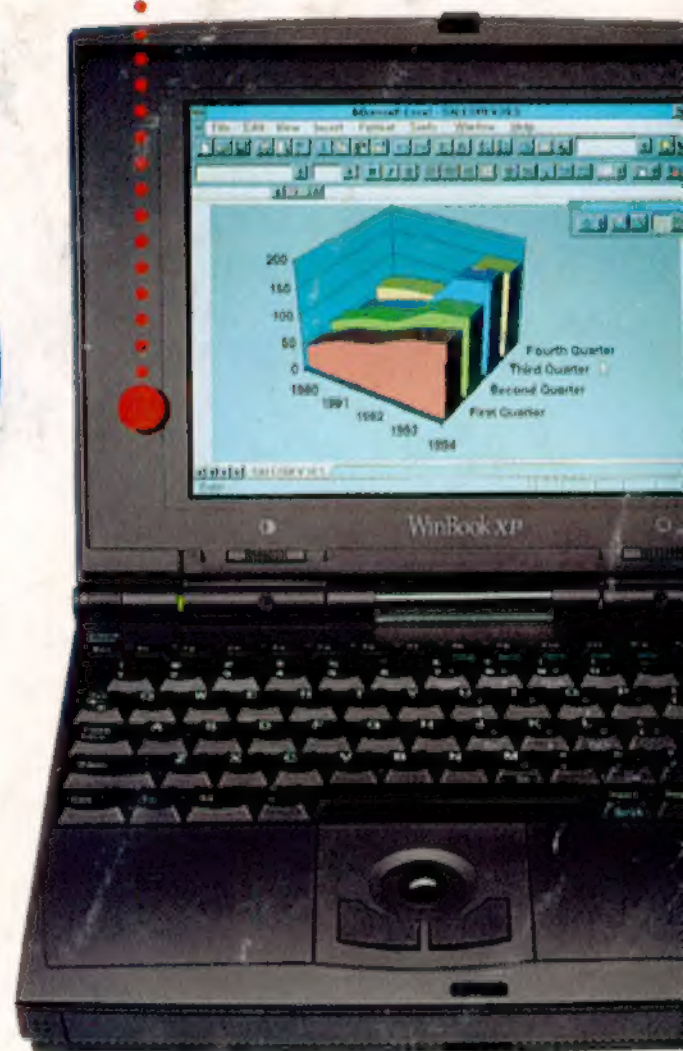
Network Edition Extra!
Communications Servers Dial You In

PC Labs Tests **70** Notebook PCs

● Full-featured
multimedia
notebooks

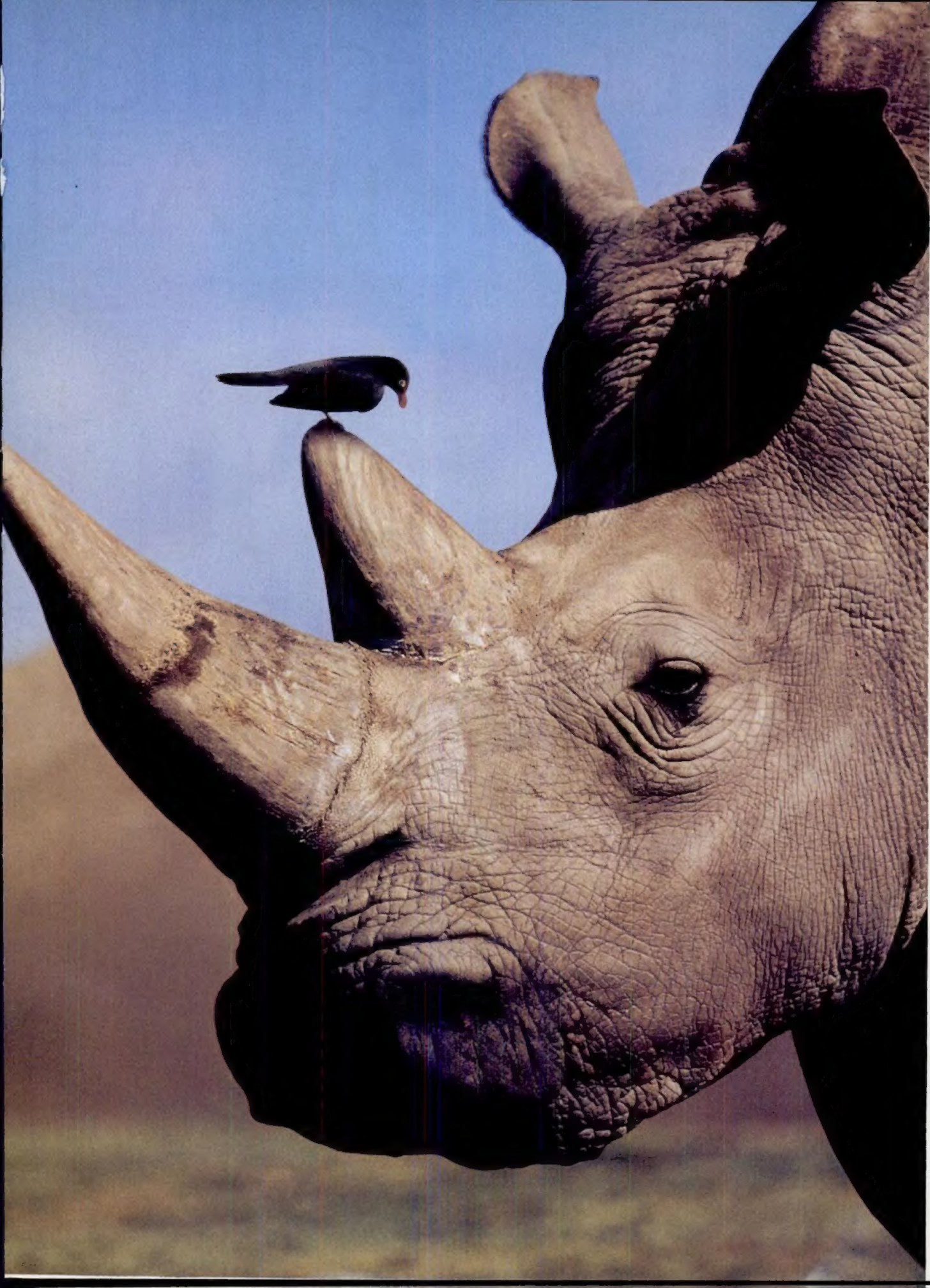


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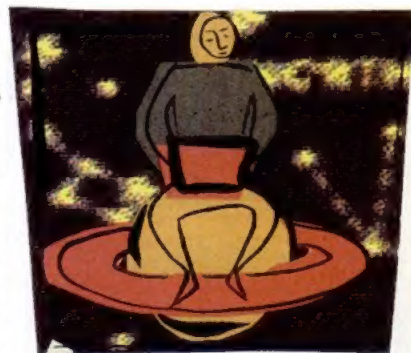
Two Places at Once").

If you need to get information from your network on a more regular basis, you might want to look into one of the remote access servers ("Extend Your Reach"). These devices reside on

mobility. The problem? You're on the road, in your hotel room or in some remote office, and you desperately need some file you've left at the office, either on your machine or on some network server. What are you going to do?

Thankfully, there are a number of solutions to the problem, and in this issue we take a look at two of the most promising. The simpler is remote-control software—packages that let you dial into your computer and take control of it, allowing you to run applications, transfer files, and access the network. This genre of software has really been improving lately; now you can even take control of graphics applications. We're also seeing some PC companies bundle these packages, mostly so that they can provide better technical support and troubleshooting. Associate editor Ted Stevenson

and project leader Amarendra "Tino" Singh head this issue's look at remote-control packages ("How to Be in



your network; they let you dial up and connect from a remote site. Your PC looks and acts just as if you were on the network, albeit typically at a somewhat slower speed. Associate editor Gail Shaffer and project leader Robert Lipschutz coordinated this story.

Shaffer, Singh, and Stevenson work out of our editorial offices and PC Magazine Labs in New York, while Lipschutz and his team work out of ZD Labs in Foster City, California. Of course, they all travel, particularly with shows like Network+InterOp and Spring Comdex coming smack in the middle of our testing for this issue. Practicing what they preach, the teams often compared notes over remote links.

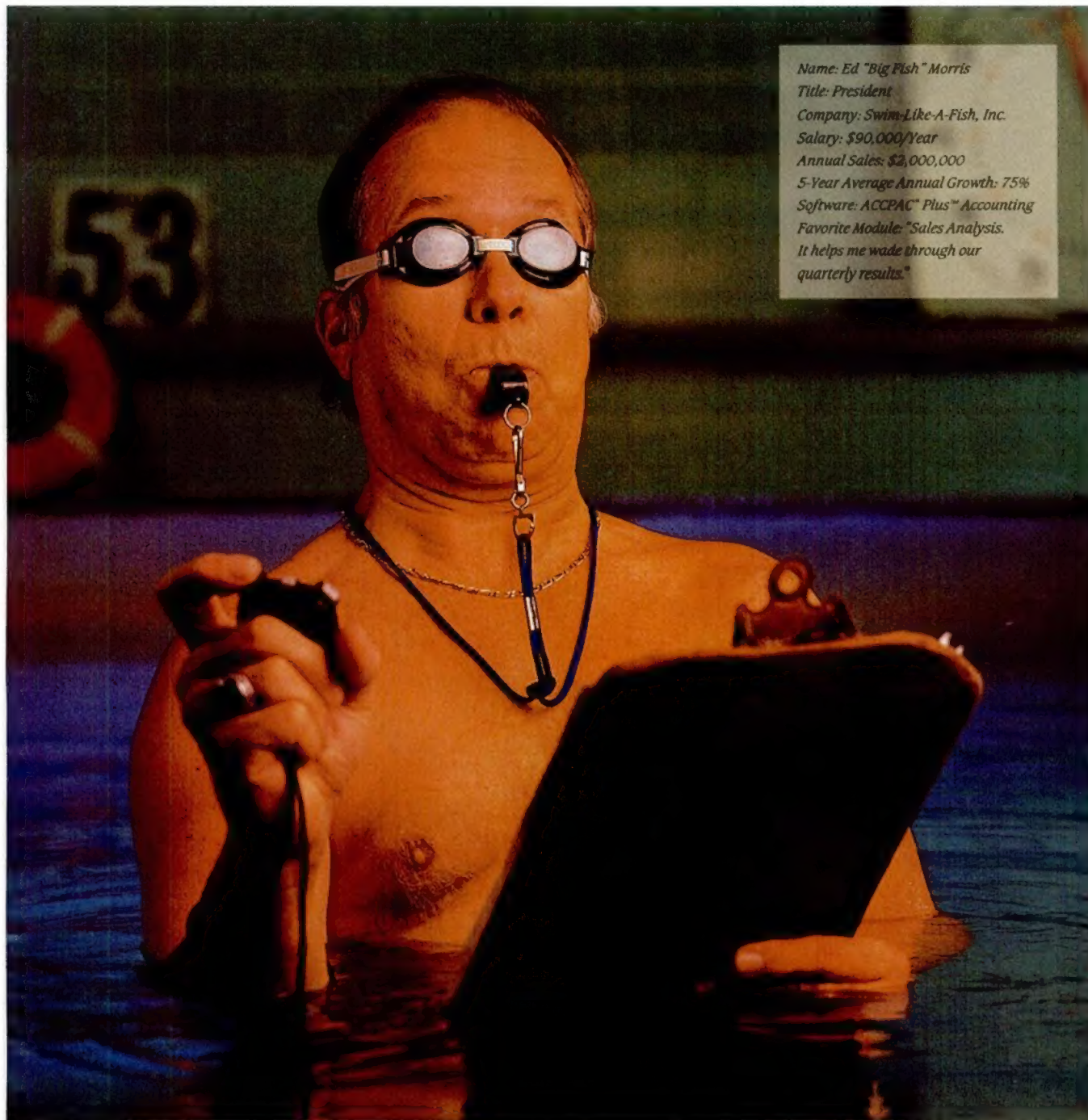
The combination of great notebook computers and better-than-ever methods for accessing data in remote locations is bringing the promise of communications anywhere, anytime closer to reality.

—Michael J. Miller

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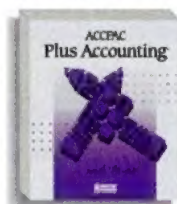
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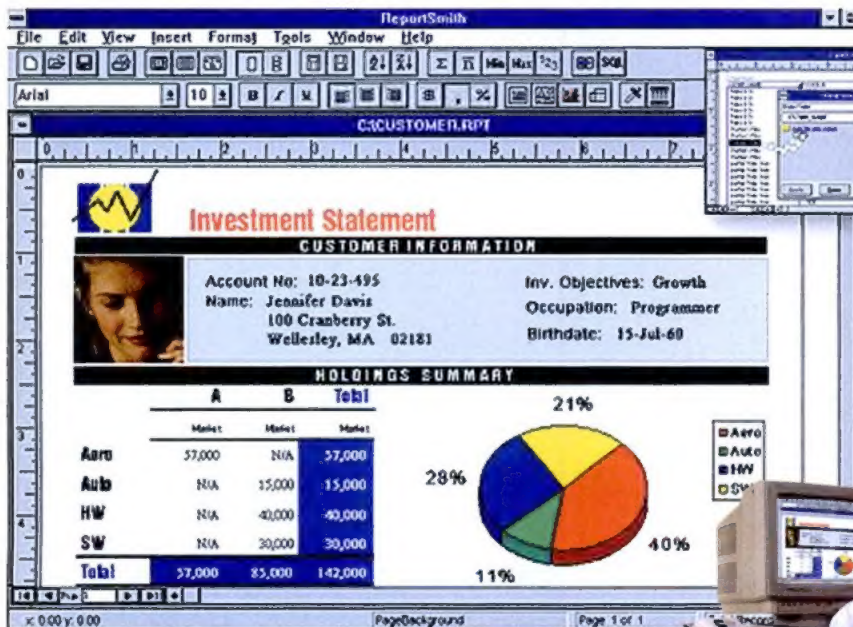
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COVER STORY

Notebooks

The Spectrum of Choice



BY BILL HOWARD We've come to expect it: Every year, portable PCs manage to pack more power into smaller packages. New, low-wattage processors like Intel's DX4 line now allow power users to grind numbers and text without taking a huge bite out of battery life. Can you truly take the power of a desktop on the road? *PC Magazine* tests 70 portables to find out112

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Notebooks

Special Insert: On the Road

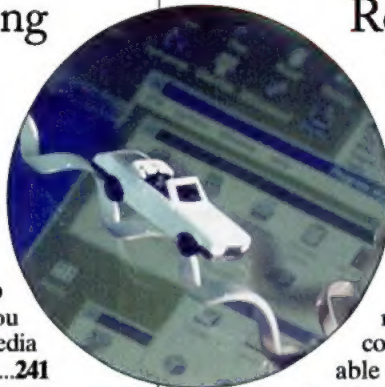
Wouldn't it be great if a gentle voice could remind you of everything you need to take on the road along with your portable PC? Here's the next best thing: a pull-out guide to portable computing with useful tips, phone numbers, and other valuable information to help keep the PC gremlins at bay while you're traveling.....234

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Portable Multimedia: Taking Your Show on the Road

BY M. DAVID STONE Imagine giving exciting multimedia presentations using only your notebook and a few lightweight add-ons. We've tested portable CD-ROM drives, sound devices, and speakers to see whether you can take multimedia with you.....241

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Remote-Node Servers: Extend Your Reach

BY FRANK J. DERFLER, JR. More and more people work away from the office, either at home or while traveling. Connecting these remote users back to a LAN is quickly becoming crucial to business. When you make the move to set up remote access on your LAN, you want a remote-node server that is easy to install, configure, and use—and that provides a reliable connection for remote users. We test ten remote-node servers and their software315

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BY BRUCE BROWN Now you can get excellent print quality, fast performance, and even color output from printers that weigh as little as 3 pounds and fit inside your briefcase. We test six battery-powered printers under 10 pounds to determine what, if anything, you have to sacrifice for portability253



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BY TED STEVENSON Work is work no matter where you do it. But with a modem and one of the eleven DOS-, Windows-, or OS/2-based remote-control packages we review, you can break the confines of your office and make your workspace any space you choose275

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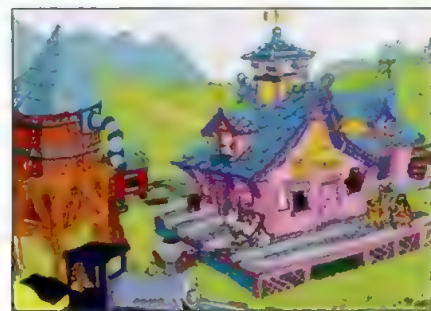
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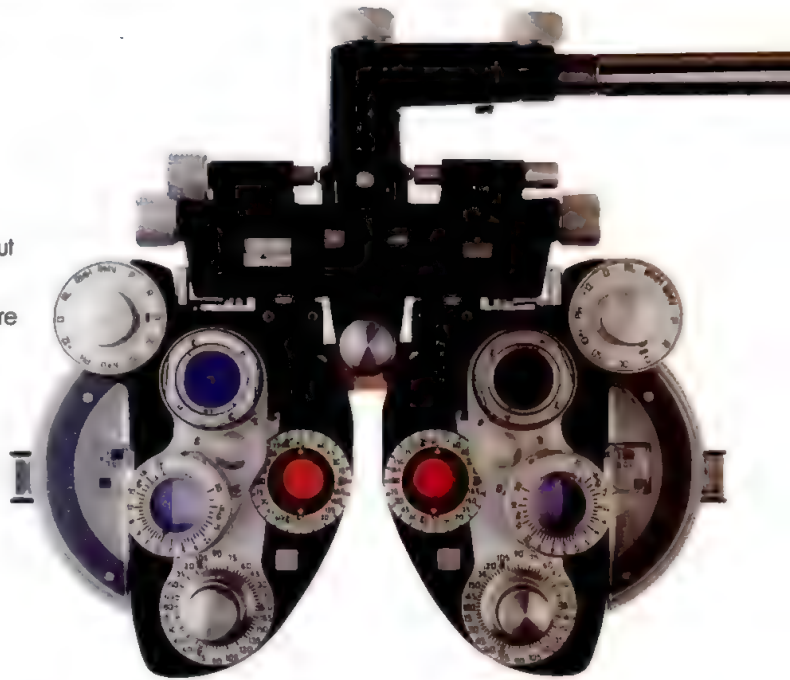
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Letters

DON'T DODGE RAM REALITIES

Since your investigation "How Much Memory Do You Need?" (May 17, 1994) states that most people don't run more than one application at a time, you could have more accurately concluded that for most users, Microsoft Windows runs fine on 4MB, but 8MB are recommended—not just for running Windows 3.1 but as a bare minimum for Chicago (Windows 4.0), too.

*Bob Vest
via the Internet*

Memory is not the sole issue. Even if I'm left with 87 percent of my installed memory available, I'll get a message declaring I'm out of memory when I try to use resource-intensive applications because I have only 33 percent of my system resources available. Until there is a way to eliminate the system-resources limitation, having more memory just isn't enough.

*Paul Zorovich
via the Internet*

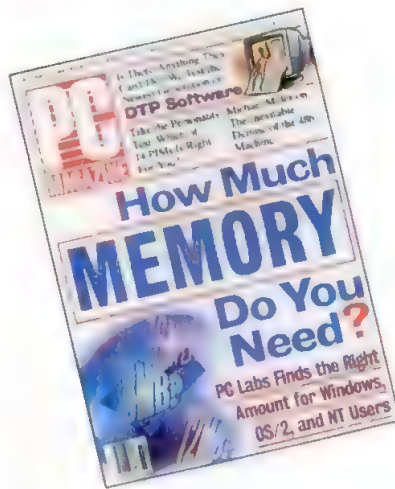
Your memory story reveals that Windows NT will give you about half the performance of Windows 3.1, provided that you can afford to give it about twice as much memory. If this trend continues, by the turn of the century we'll have operating systems that use 1GB of memory and a 500-MHz processor to turn in performance approaching that of the original 8088-based IBM PC. I can hardly wait!

*John R. Carlson
via PC MagNet*

Although I appreciated your memory story, according to your own tests, OLE 2.0 still seems unsuitable for any type of intensive work. Even with 8MB of "sweet spot" memory, OLE 2.0 crawls. I'm surprised so little was made of this overwhelmingly poor performance.

*S. James
via the Internet*

You say that Windows NT uses a dynamic cache, while OS/2 uses a static cache, and that you chose not to reconfigure OS/2's cache for your tests. Though it may be true that Windows NT's dynamic cache is bet-



*You'll need 8MB of RAM
for Windows 3.1 and
as a minimum for Chicago.*

ter, I would think that OS/2 users would reconfigure their disk cache when they add more RAM to achieve optimal performance. You chose not to do so and ended up comparing apples to oranges.

The casual reader who peruses the eye-catching graphics will be left with the false impression that OS/2's disk throughput is dismal when compared with that of Windows NT, regardless of the amount of RAM in his machine.

*Bob Dover
via PC MagNet*

Most users don't run single applications; they have several applications active at one time. The memory sizes you quote should be considered minimums, not the norm. Memory should be at least 50 to 100 percent higher to be truly functional.

*Lloyd E. Underhill
via PC MagNet*

• We received a tremendous amount of mail in response to our memory story, and not every one agreed with our recommendations. Of particular concern was our chart comparing Windows NT disk performance with OS/2 disk performance. We probably should have noted in the chart as well as in the text that Windows

NT uses a dynamic cache, and we used a 1.7MB disk cache throughout the OS/2 tests. As many pointed out, Windows for Workgroups 3.11 is a better performer than Windows 3.1, largely because of its 32-bit disk and file access. For an excellent discussion of Windows system resources, see Jeff Prosser's Tutor column in our issue of April 13, 1993. Everything will change, of course, when the next version of Windows arrives.—Ed.

LOGGING ON TO TROUBLE

Robin Raskin's Pipeline column "Why Stay Off the Highway?" (April 26, 1994) provides excellent reasons to stay off the information highway. I've encountered excessive delays when logging on, additional delays once logged on, and even more delays when logging off. I've tried to chat with people who suddenly vanish in mid-thought, and I've chatted with women only to find out they were really men. This reminds me of a dirt road in untamed territory, not a paved highway through a sane country.

*John O'Donnell
via the Internet*

By implying that all Internet users are lazy lunatics who waste their time playing with computers, Raskin's column strikes me as cynical and elitist. If I want "misinformation," all I need to do is watch my television or browse through a newspaper. Even though there's still much work to be done, most users will be amazed and delighted at what can be found on the Net.

*Chris Nelson
via the Internet*

Although Gopher, Mosaic, and WAIS are all very powerful and useful tools, I concur with Raskin's assertion that the information highway is inefficient. For myself, I can't justify the amount of time that I spend learning to install, configure, and use these applications. As a computer professional, however, I can drastically reduce the learning curve for others who want to employ these tools to use the Net productively and efficiently.

*David Paul
via the Internet*

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LETTERS

A PEER OF A DIFFERENT COLOR

In your April 26, 1994, networking comparison "Peer Pressure," you compare various networking products and pricing. *PC Magazine* did not indicate clearly, however, whether each networking product included cabling, hardware, software, and so on. All of Moses Computers' products are complete packages containing all cabling, documentation, hardware, and software.

The tests performed on the networks did not resemble the normal traffic on a peer-to-peer setup. The traffic was controlled, and the configuration avoided normal network collisions. This is another situation in which Moses's technology shines, but because of the testing methodology, this never became apparent.

Finally, you didn't really show price versus performance and how complicated each system is to use. Instead, all systems were simply compared with high-end, full-featured networks.

David McCallen
Director of Communications
Moses Computers
Los Gatos, California

• We tested 13 peer-to-peer networks that offer the basics for small workgroup computing: file, printer, and other device sharing and in some cases, group scheduling and e-mail.

Of the products we tested, 11 are compatible with standard Ethernet adapters, while two of the vendors—MosesALL! for one—bundle proprietary adapters. We gave pricing for software only in most cases, which tells only half the story. To clarify pricing issues for bundled packages:

MosesALL! uses 8-bit proprietary adapters, yet the complete system is bundled with cable and software and costs \$89 per node. Creating a virtual hub that supports up to 74 users costs an additional \$139; the price per node in a five-node LAN with the virtual hub averages \$99.

With other packages, you buy the software and hardware separately. The representative cost of five 16-bit ISA Ethernet adapters is \$645 (for five at suggested retail price from 3Com Corp.) With this cost factored in and coaxial cabling used, the per-

node costs range from about \$170 for products such as Artisoft's Simply LANtastic, Performance Technology's PowerLan, and Tiara Computer Systems' 10NET 5.1 LAN Operating System to about \$220 per node for Novell's Personal NetWare to around \$370 for Microsoft Windows for Workgroups—note that WfWG requires an additional purchase for DOS support but also that it comes installed on many new PCs at no extra cost. In addition, the overall cost is lower when you factor in street pricing for Ethernet adapters: They run about \$49 to \$69 per card. (Note that a 10BaseT-based star configuration would require a hub. The base price for an Acc-ton 8-port 10BaseT hub—with a suggested retail price of \$199—would increase the cost by about \$40 per node.)

Relative to independent network adapters, MosesALL! has a low price per node; but other, more complex packages offer better performance and added functionality.

With regard to performance testing, although each network is different, we chose to perform single-client tests because in many small workgroup peer-to-peer LANs, the traffic at any one time consists of a single conversation. For a more complete picture of this field and our testing

and review approach, see our peer-to-peer story in our issue of April 26, 1994.—Ed.

THE CD-ROM DEBATE SPINS

The letter in which Clyde E. Stauffer characterized CD-ROMs as toys was amusing (Letters, "A Brave New CD-ROM World," April 26, 1994). Document imaging is already widely used to scan legal documents and medical records onto CD-ROM for use by lawyers and doctors off-site. Each case eliminates the need to transport unwieldy piles of documents. Not bad for a "toy."

Brian McDougle
via PC MagNet

Mr. Stauffer's letter questioning the need for CD-ROMs, while extreme in its conclusion, conveys a fully understandable attitude. I have been consistently disappointed with the CD-ROMs I've purchased, whether for business or for personal use. The often astronomical cost of test-driving these CD-ROMs makes them an unpalatable option.

Stephen A. Milford
via PC MagNet

• Look for our roundup of 100 great CD-ROM titles in all kinds of categories in our issue of September 13, 1994.—Ed.

CORRECTIONS AND AMPLIFICATIONS

Contrary to our statements in the "High-End Workflow" article (June 14, 1994), IBM's FlowMark does not require OS/2 LAN Manager; the functionality that LAN Manager provides is built directly into FlowMark.

We inadvertently misspelled the name of contributor Mark Januszka, who is with Fusion Systems Group of New York City, in our story "Pentium vs. PowerPC: Battle for the Desktop" (May 31, 1994).

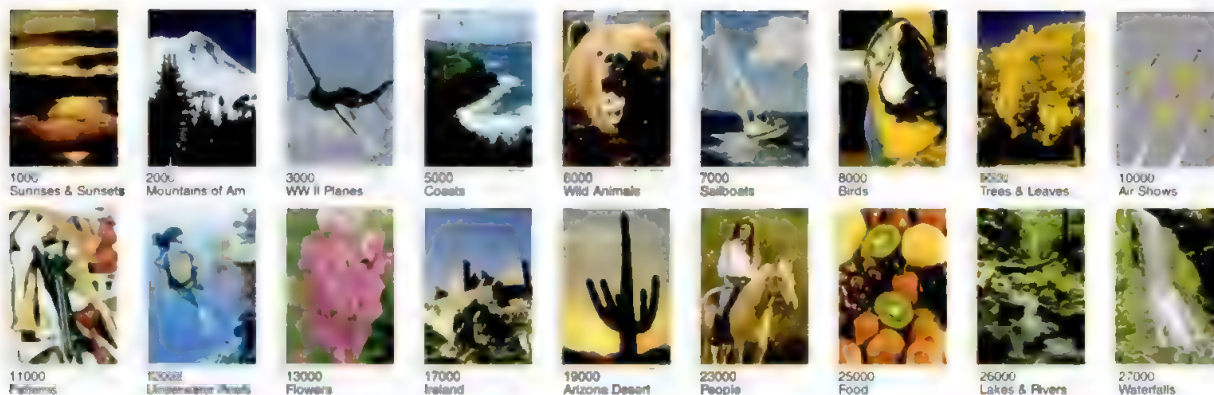
The correct phone number for Workflow Inc. ("Lotus Notes and Its Add-Ons," June 14, 1994) is 610-459-9487.

PC Magazine improperly cited the Cirrus Logic 5428 video chip set as a contributor to an apparently low Winstone 94 score in the First Looks review of Hewlett-Packard's HP Vectra VL2 4/100 PC ("\$2,500 DX4 Systems Break

Exciting New Ground in 486 Price and Performance," April 12, 1994). In fact, the low reported scores were caused by improper configuration of the system during testing and were not related to the video subsystem. A retest of a properly configured system showed an above-average Winstone score.

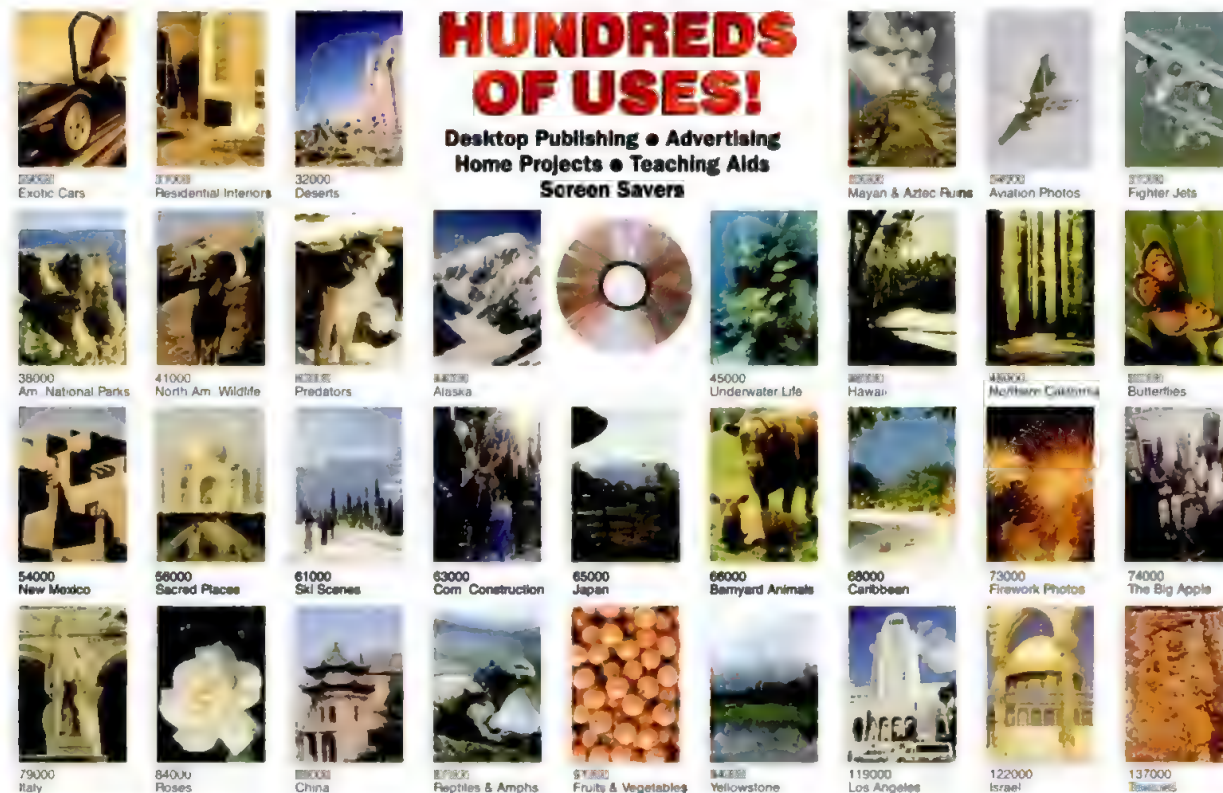
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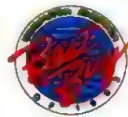
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- NiMH battery & AC adapter
- 80-key keyboard, built-in trackball
- Serial, parallel, external VGA video port
- MS-DOS 6.2, Windows for Workgroups 3.11, Lotus Organizer

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- 640 x 480 backlit 7.4" display
- 256K (386SL) or 512K (486SL) video RAM
- Custom nylon carrying case
- Internal fax modem
- NiMH battery, extra battery & AC adapter
- 80-key keyboard, built-in trackball
- Serial, parallel, external VGA video port
- MS-DOS 6.2, Windows for Workgroups 3.11, Lotus Organizer

386SL-25 \$1595 486SL-25 \$1995

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- Intel 33MHz 486SL CPU
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- 4MB RAM
- 180MB IDE hard drive
- Internal 3.5" 144MB floppy drive
- 640 x 480 backlit 9.4" display
- 512K video RAM
- NiCad battery & AC adapter
- Custom nylon carrying case
- 81-key keyboard, built-in mouse key
- Serial, parallel, VGA, keyboard ports
- MS-DOS 6.2, Windows for Workgroups 3.11

486SL-33 \$1995

PACKAGE 3

- 8.5" x 11.3" x 1.75" to 2.25", 5.6 lbs.
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- Internal 3.5" 144MB floppy drive
- 640 x 480 backlit 9.4" display
- 512K video RAM
- Internal 96/24 bps send/receive fax modem
- NiCad battery, extra battery & AC adapter
- External charging stand
- Custom nylon carrying case
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- Serial, parallel, VGA, keyboard ports
- MS-DOS 6.2, Windows for Workgroups 3.11

486SL-33 \$2395

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- **Accessories**
Extra battery **\$50**
Custom nylon carrying case **\$79**
DC-AC converter **\$69**
External charging stand **\$69**

PACKAGE 2

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- Intel 33MHz 486SX CPU
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- 120MB IDE hard drive
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- PCMCIA slot Type I, II, III
- Local bus video, 512K video RAM
- 640 x 480 dual scan color VGA backlit 9.5" display
- NiMH battery & AC adapter
- 82-key keyboard, trackball
- Serial, parallel, external video, mouse port
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486SX-33 \$2395

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- **Accessories**
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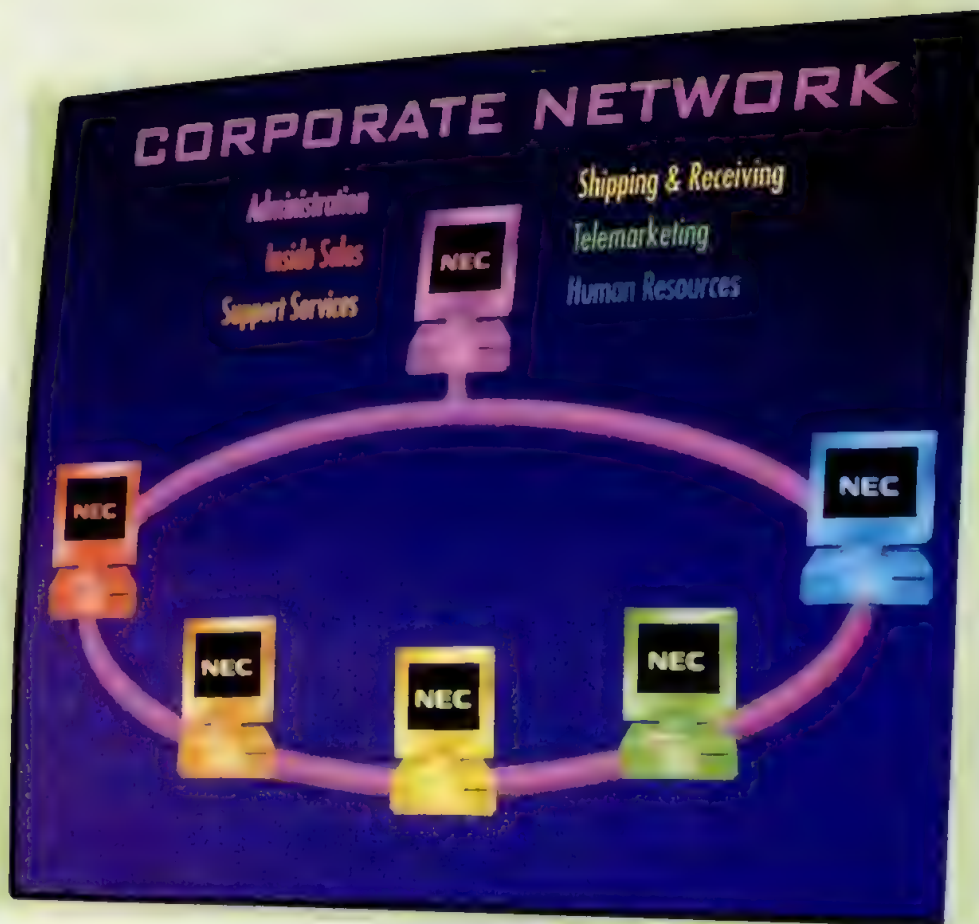
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CIRCLE 045 ON READER SERVICE CARD

At last, a truly powerful project management software program that can talk with everyone and everything in your company. New Time Line 6.0 for Windows.

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CIRCLE 117 ON READER SERVICE CARD

Business in Cyberspace

Commerce ventures into the Internet.

Entrepreneurs are just beginning to hang their electronic shingles on the Internet. The National Science Foundation's "acceptable-use policy" has always decreed that the Internet's research and education status precludes commercial use, but with the arrival of alterna-

tive Internet connection schemes (such as the Commercial Internet Exchange) and the meteoric growth of public access, interest in developing the Internet's commercial potential seems unstoppable.

Today there are an estimated 20 million Internet users, and pioneers have begun to mine the network for commercial gold. CommerceNet, a public/private venture funded in part by the Department of Defense's Technology Reinvestment Project, will provide Internet service for businesses that want to buy, sell, and advertise products and services. The Silicon Valley consortium behind CommerceNet wants to link chip manufacturers and system designers, information providers, and consumers. Its backers believe that the system can cut production schedules by 80 percent and reduce costs. The Internet Shopping Network plans to sell discount computer products through CommerceNet.

MecklerWeb, a marketing center for corporations that will provide information in the form of text, audio, graphics, and video, will also join CommerceNet. The service will be organized by topic as a

multimedia yellow pages.

Other large-scale projects include publisher O'Reilly & Associates' Global Network Navigator, an advertising-supported magazine and virtual store, and the Internet Co.'s Electronic Newsstand, where you can browse through magazines, get information on discount airline tickets, and shop for cars.

Several questions about doing business in cyberspace remain. How do you pay for virtual transactions? How do you identify customers? How do you make secure connections? With security and identification features planned for Mosaic (an Internet front end) businesses will be able to identify customers and providers and make electronic payments. These features are already

integral parts of CommerceNet and MecklerWeb.

Some companies avoid the security issue by using the Internet only to communicate with their customers. Joe Boxer, the underwear manufacturer, displays its Internet address in advertisements. The company says it gets 20 to 30 messages per day and answers every one. —Nate Zelnick



Buyers and sellers meet on CommerceNet.

Digital Visionaries

PC MAGAZINE RECENTLY SPOKE with Mark Andreessen of Mosaic Communications about the commercialization of the Internet. Andreessen, 22, is one of the architects of Mosaic, a graphical Internet interface, and recently cofounded the company to help businesses and consumers use the Internet as an electronic marketplace.

Q: How can the Internet be open for business when on-line veterans are discouraging advertising?



Big Internet plans.

M.A.: There are many ways to leverage off the Internet and conduct commercial transactions that do not infuriate the existing community. Advertising is done through Mosaic today, and many companies effectively use the Internet for marketing and advertising in a friendly way that involves providing information or useful services.

Q: What technical barriers are there to doing transactions over the Internet?

M.A.: The ultimate technology is RSA public/private key cryptography. There are some technical issues regarding authentication—such as who manages the keys for millions of users—but there are really no unresolved issues as far as how to encrypt.

Q: How will your company's CyberSpace Mall get businesses on the Internet?

M.A.: We'll allow companies to lease space on our server complex. Virtually every company in the world wants to give out information about itself and its products. The initial market includes everybody from car companies to food companies to anybody who produces anything.

Q: How will the Internet look in a year?

M.A.: I expect to see a user base of about 60 million consumers and business users, and I expect to see security built into more commercial software products. Consumers don't yet transact over data networks very much. I think that's going to start happening this year. —Carol Levin

Pipeline By Robin Raskin

A Perfect Opportunity?

Round one of the suite wars found WordPerfect/Borland desperately trying to keep pace with Lotus SmartSuite and Microsoft Office. Quickly, the two cobbled together Borland Office (a blend of WordPerfect, Quattro Pro, and Paradox). The integration and common look and feel among the applications certainly existed, but you got the distinct feeling that you were using products from two very different companies.

Now, Novell and WordPerfect are at the brink of formalizing their "mother of all mergers." Winning the suite war is clearly one part of the new company's agenda. The plan is to release a trio of integrated packages that go by the new moniker Perfect Office. The Perfect Office Standard Edition will include WordPerfect 6.0, Quattro Pro 4.0, Inspire (WordPerfect's new name for its old Windows presentation graphics package, WordPerfect Presentations), InfoCentral (the new PIM from WordPerfect's consumer division, Main Street), and the remote-office client from Symmetry 4.1 (Symmetry is the new name for WordPerfect Office). The whole shebang will be priced competitively (and we know who they're watching), and the program menus will share a common look and feel.

The DAD (Desktop Application Director) is going to try to best Microsoft Office's current implementation of MOM (Microsoft Office Manager). According to WordPerfect, you'll be able to select tasks such as "Create Report" from DAD and



have Perfect Office launch the proper template automatically. Of course, Lotus is planning a centralized toolbar, too. The Professional Edition of Perfect Office includes Paradox (WordPerfect licensed 1 million copies from Borland) and Visual AppBuilder (Novell's AppWare-based visual programming language).

The most intriguing and market-savvy of the Perfect Offices is the CD-ROM incarnation, Perfect Office Select. With the CD-ROM, you can first try and then build your own custom suite by choosing from WordPerfect apps, including Informs, Express-Fax, and others. The CD-ROM will even include some third-party apps that have been "Perfect" enabled, as well as "links" to other popular software such as Excel and Lotus 1-2-3. Perfect Office Select is an opportunity to have "best of breed" apps done to your specifications.

With products due in September, the development schedule is an ambitious (almost insane) one. There are many promises to keep. OLE 2.0 will be in all the key apps. There will be significant amounts of shared code and task automation using Perfect Script. And of course there's the Novell tie-in. Initially, the suite will offer the NetWare Navigator to help management and distribution of the suite, but ultimately the links to NetWare should be even more powerful.

Having 16.2 million current WordPerfect users is certainly not a bad starting ground for sales. By shipping a major release this fall, WordPerfect beats developers who are waiting for Chicago. It's a long shot, since Microsoft Office has gained tremendous market share, but for Novell/WordPerfect it's an almost Perfect Opportunity to establish a "proof of concept" as a major player in the desktop application world.

Robin Raskin is editor of PC Magazine.

Survey Reveals Psyche of Wired Society

PEOPLE WITH HOME COMPUTERS are nerds who don't get out very often, don't exercise regularly, and have poor eating habits, right? Look again, because that stereotype of computer users has officially been replaced by a much more flattering portrait, according to a recent study of technology in the American household conducted by the Times Mirror Center for the People & the Press.

Based on phone interviews with over 3,500 adults and 400 teenagers, the study explored how new technologies impact behaviors such as reading and watching television, and also brought to light some disturbing and some promising trends.

The bad news first. The spread of technology in American society is uneven. A college graduate with a family income of \$50,000 a year is ten times as likely to own a home computer with a modem than a non-graduate who earns less than \$30,000.

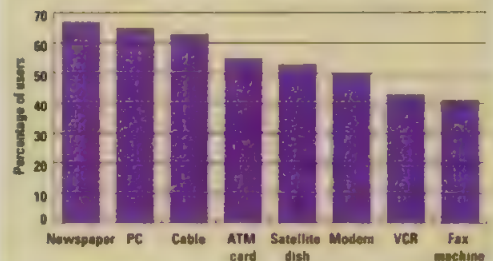
The good news is that the gender gap in

computer usage among adults could disappear when today's generation of kids grows up. Among teenagers surveyed, 40 percent of the boys and 32 percent of the girls were occasional users of their home PC. Among adults, 18 percent of men and only 9 percent of women use a home PC often. Other notable findings:

- ▶ Nearly one in three households has a personal computer.
- ▶ 46 percent of teenagers surveyed have a home computer.
- ▶ One out of 10 households has a modem;
- ▶ Most computer users say technology gives people more rather than less control over their lives.
- ▶ Computer users read for about 58 minutes a day and watch 2 hours of television, while people without a computer read for about 47 minutes and watch 2.5 hours of television.
- ▶ 63 percent of users of on-line services

Don't Take Away My PC

Among those polled who use each medium, the indicated percentage said they would miss it "a lot" if it were taken away. Only newspaper readers surpassed PC users for attachment to a technology.



Source: Times Mirror Center for the People & the Press

scored high on a current-events quiz, compared with 28 percent of those from a comparable background who do not use computers.

▶ Home computer users are as likely as non-computer users to participate in athletics and to go out often.

▶ 15 percent of modem users take naps, compared with 23 percent of non-computer users.—Carol Levin

Hard Disk Turbochargers

LOCAL-BUS VIDEO WAS LAST year's performance booster. This year, PC vendors are focused on getting hard disks to keep up with today's faster CPUs and big applications. Powerful new IDE and SCSI drive controllers should be standard issue on high-end PCs by year's end.

Even if you don't want to spring for a new PC, you can still boost hard disk performance by adding one of the new generation of hard disk controllers.

The fastest controllers are local-bus cards, such as Promise's DC2300 Plus and Acculogic's IDE-4 VL, that conform to the

Hard Disk Performance Boosters

A new generation of hard disk controller cards that speed data transfers is expected to hit the market this summer. While PC makers are building improved controllers into new high-end PCs, you can add these cards to existing PCs.

Products listed in alphabetical order

	Acculogic IDE-4 VL	Adaptec ATA-2825	GSi 4C-VL	Promise DC2300 Plus	Tyan Computer S1362
Estimated street price	\$99	\$200	\$169	\$100	\$70
Local bus	VESA	VESA	VESA	VESA	PCI
Top data transfer rate	11MBps	11MBps	13MBps	13MBps	11MBps
Super I/O	■	□	□	■	■

Enhanced IDE specification and transfer data at up to 11MB per second when plugged into a VESA local-bus slot. The DC2300 Plus supports DMA burst transfers of up to 13.3 MBps—about 10 times as fast as a standard ISA-based controller. Both control up to four IDE devices, including hard disks as large as 8.4GB, floppy disk drives, tape drives, and IDE CD-ROM drives. That takes the IRQ hassle out of installation.

GSi's 4C-VL adds another pair of IDE connectors so you can control eight internal

devices without having to daisy-chain them or take a performance hit when you add a new device. At the high end, Adaptec's Total Advantage VL controls four internal IDE devices and seven SCSI-2 devices, including scanners, tape drives, and optical drives.

Many of these VL-Bus cards are equipped with new Super I/O chips, so you also get a pair of buffered 16550 UART serial ports and support for Enhanced Capabilities Port that boost external parallel-port throughput.—Mike Hogan

Top Retail Software

Current ranking	Last issue	Product/ company
1	2	MS DOS 6.21 Upgrade Microsoft Corp.
2	11	Procomm Plus for Windows 1.02 Datastorm Technologies
3	9	Delrina WinFax PRO 4.0 Delrina Technology
4	7	MS Access 2.0 for Windows Microsoft Corp.
5	6	MS Windows 3.11 Microsoft Corp.
6	5	MS Office 4.2 for Windows Upgrade Microsoft Corp.
7	13	MS Windows for Workgroups 3.11 Microsoft Corp.
8	14	Procomm Plus 2.01 Datastorm Technologies
9	12	MS Office 4.2 for Windows Microsoft Corp.
10	—	MS Publisher 2.0 for Windows Microsoft Corp.
11	—	MS Works 3.0 for Windows Microsoft Corp.
12	—	QEMM 7.0 Quarterdeck Office Systems
13	—	Corel Gallery 1.0 Corel Corp.
14	8	MS FoxPro 2.6 for Windows Microsoft Corp.
15	—	Sharkware 1.0 Cognitech Corp.

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending June 4, 1994. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

Grind It, Freeze It, Recycle It

ENVIRONMENTAL AWARENESS IN the PC industry got a big boost with Energy Star, an energy-conservation program launched two years ago by the U.S. Environmental Protection Agency, but that was just the beginning. Today, there are global efforts underway to cushion the environmental impact of the PC throughout its life cycle—from the materials used in manufacturing to the disassembling and recycling of its parts. Environmental computing could be the next battlefield in global competition.

"We need to take a holistic view from raw materials to reuse, cradle to cradle," says Bob Ferrone, vice president of environmental management systems at Excel, a Connecticut-based technology consulting firm. While Energy Star addresses electrical consumption, there are several other components of a truly green PC—an ecomachine.

Innovative technologies for building an ecomachine include the clean manufacturing of chips, the disassembly of PCs, the separation of plastics for recycling, the treatment of waste from circuit-board production, and the recycling of floppy disks and CD-ROMs.

Cryogenics, one CD-ROM recycling method under development, subjects CD-ROMs to temperatures way below freezing. Since different materials expand and contract at different rates, the crystallized materials

can be separated for recycling. And in chip manufacturing, the U.S.

government-funded Sematech consortium is working on recapturing chemicals and reducing toxic-waste streams, says Ferrone.

The industry is also investigating the recovery of a monitor's polymer casing and glass. In fact, the shingles of one McDonald's restaurant in Chicago are made from recycled monitor cases.

In the U.S. today, ecolabeling is just getting off the ground. A few "environmentally preferable" products wear the Green Seal label if they meet strict standards for materials, manufacturing, packaging, and disposal. Green Seal, a Washington, D.C.-based nonprofit organization is now looking at certifying PCs, says Dr. Arthur Weissman of Green Seal. Another part of the picture is "Take Back" programs that let customers take used computers to recycling centers or have them collected much as recyclables are collected today.

Meanwhile, the European Community has developed an ecolabeling program and is moving ahead with plans for dismantling and recycling products. Gilbert Dubois, counselor for the Delegation of the European Commission in Washington, D.C., wants to see "disassembly" lines, such as those currently used for Fiat and BMW, also adopted by the computer industry.—Carol Levin



Report on Support, Part 2

FOR THIS, THE SECOND PART OF OUR report on software support, we spot-checked the quality of technical support for graphics applications. We called as ordinary customers—not as editors of *PC Magazine*. For the most part, the tech support we received was professional and helpful, and the staffs involved were very relieved to be answering “how to” rather than “why not” questions.

We asked three presentation-graphics vendors the following question: “How do I create a custom template or master?” The answers we received ranged from step-by-step instructions to a theoretical discussion of when templates are useful. Lotus Development Corp.’s tech support of

Freelance for DOS and Freelance for Windows was patient and detailed; the staff gave us more information than was available in the manual, talking us through the creation process and then reviewing everything we’d been taught. The same was true of Software Publishing Corp.’s support for Harvard Graphics. We received instruction on two ways to complete our task, as well as a lesson in the advantages and disadvantages of each approach. The staff also anticipated what would likely be our next call by explaining how to make the new template available in other presentations. Microsoft PowerPoint’s



support was gracious enough to help even though we couldn’t find the required customer number. The staff’s responses were more theoretical than practical, however; we now know what a template is, but not much more about how to create one

than we did when we began.

We asked staffs of desktop publishing products: “How do I create a custom stylesheet?” The help we got here was universally flawless. Those who fear Ventura Publisher will get lost in the shuffle over at Corel Corp. can rest easy. The Ventura support staff answered questions patiently and thoroughly; these support techs even offered design advice. At Aldus PageMaker, the wait was short, the help courteous, professional, and detailed. The staff went into great detail on composing a stylesheet, and then offered advice on when and how to combine multiple styles into a template.

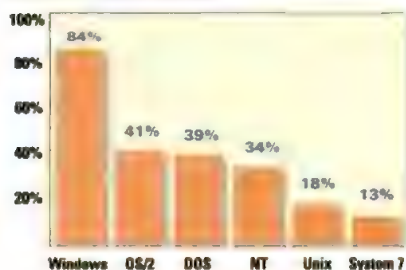
For the illustration products, the question was: “How do I wrap paragraph text around a graphical object, and can I control the offset?” Responses here ranged from somewhat bewildered to brutally honest, but in all cases involved an average 4-minute wait to be connected to a human. In dealing with Micrografx Designer’s tech support, we twice received detailed instruction on what is a relatively simple process and on a third occasion, our technical helper seemed a bit confused. At CorelDRAW, the support people thoroughly explained the text-wrapping process, and acknowledged that text-wrapping is more involved in CorelDRAW than it is in other packages. Over at Adobe Illustrator, the biggest challenge was figuring out the support policy, which relies on a system of free and purchased credits, customer numbers, and case numbers. Once we wended our way through the maze of push-button replies, we found support brisk and thorough. The staff even offered some not-so-obvious shortcuts for controlling text wraps.

For Micrografx Windows Draw, we asked technicians a different question: “I saved a Windows Draw file in EPS format and now can’t open it in another application. What do I do?” After yet another long wait, we received instructions on how to create a usable file, but no real explanation as to why our approach didn’t work. The support was helpful in troubleshooting, but not particularly technical. But this may be deliberate since Windows Draw is targeted at nonprofessional users.—Gayle C. Ehrenman

Briefs

THE RESULTS ARE IN: PC MAGAZINE

subscribers who took part in a recent survey on software purchasing habits were asked which operating systems they’re considering buying in the near future. Their choices:



BRAGGING RIGHTS FOR BEST CHIP

architecture were recently claimed by Intel and Hewlett-Packard. The two companies plan to collaborate to develop a 64-bit microprocessor that’s binary-compatible with Intel’s processors and HP’s PA RISC chips. Don’t hold your breath. ETA is the end of this century.

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electronically. For free 15-day evaluation copies of McAfee’s antivirus software VirusScan and NetShield, contact McAfee on the Internet (McAfee.com), or via America Online (MCAFE), CompuServe (GO MCAFE), or BBS (408-988-4004). Network management

products from the recently acquired Brightworks Development and Net Tools will soon be available electronically, as well. If you like the programs, send in your payment.

TRYING TO GET THE PEOPLE IN YOUR

organization to adopt new software? Don’t let them cast aspersions before they try it. Professor Dennis Galletta of the University of Pittsburgh’s Joseph M. Katz Graduate School of Business subjected 50 students to training on an unfamiliar integrated software package. He found that their attitudes were highly influenced by the comments made by “confederates” who either voiced expressions of excitement or groaned about how painful the exercise seemed.

The lesson: Since word-of-mouth plays a powerful role in shaping opinions, management should pay special attention to software training, communicate openly to correct misunderstandings, and make changes when the negative sentiment is well founded.

BIGGER IS BACKBREAKING. SONY IS

pushing its Trinitron displays to new limits. It recently showed a 175-pound prototype unit with a 28-inch screen that ran at 1,920- by 1,080-pixel resolution. It will sell for around \$33,000.

—Carol Levin and Chris Barr

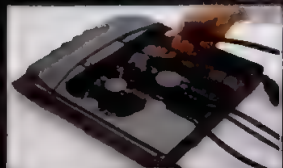
“Have you looked under your desk recently?”

Steve Bass, PC WORLD
“Hot Picks for the Home
Office” article, June 1994

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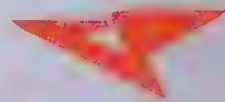
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ Graphics

CorelDRAW 5: Working on Synergy

BY LOUISA SIMONE

CorelDRAW users have eagerly awaited the release of Version 5—not because of an anticipated performance boost, but because it promised a fix for some pesky bugs that plagued Version 4 and a revamping of the classic desktop publishing program Ventura Publisher (now known as Corel Ventura). CorelDRAW 5 delivers on only one of its two promises, but makes up for it by working well with other members of the Corel family.

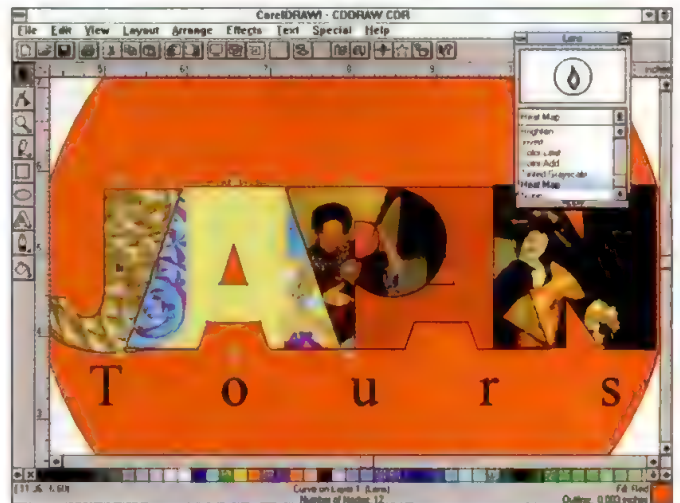
The bottom line of this \$895 (\$695 on CD-ROM) program is that in spite of the fact that its memory require-

ments have doubled, you're likely to find performance a mixed bag: The newest features (like the built-in Candela color-management system) make opening files or redrawing the screen slower, while paragraph text imports, redraws, and reflows are much quicker.



From August 1 through August 5, you can go on-line to discuss CorelDRAW 5.0 with Luisa Simone, Corel director of graphics software. Eid Eid, and Corel CEO Mike Cowpland. Type GO EXEC at any CompuServe prompt.

Perhaps the biggest boon to productivity is CorelDRAW 5's stability, a major improvement from Version 4. We created several large files—complete with imported bitmaps, clipping paths, and special effects—and printed them on a desktop laser printer (equipped with PostScript Level 2 and 6MB of memory) without a hiccup. Of



DISTORT: CorelDRAW's Lens feature (applied to the letter A) can create effects like true transparencies and heat maps on the fly. With PowerClip (applied to the letters J, P, and N), you can create clipping paths from any vector object to mask elements.

course, as in any major piece of software, there are problems: The program crashed when working with large drawings stored in older .CDR formats and switching between Custom and Default gradients caused weird behavior. Though the new gradient patterns appeared on-screen, the old gradients

printed. There have even been reports of CD installation problems, because the disks had ink smudged on them. If cleaning the disks does not solve the problem, Corel will replace them.

Corel's renewed commitment to shipping clean code is
Continues on page 40

■ Notebook PCs

Newest Notebooks Get Personal

BY TIN ALBANO

What do you look for in a notebook: size, weight, processing power, battery life, or a good screen? Chances are you look for all five, but one person's perfect portable is another's disappointment. Today, the range of components and features available can make it feel as if your notebook was custom designed just for you.

Ascentia 900N: AST's New Wardrobe

AST Research has earned a reputation for producing powerful, reliable notebooks backed up with solid and innovative engineering. Unfortunately, AST

chose to dress its now-discontinued PowerExec line of portables in plain (though functional) clothing: gray shells with ungainly pointing devices.

With the debut of its Ascentia 900N, AST has improved its looks by borrowing some of the wardrobe of IBM's

trendsetting ThinkPad PCs—including the familiar eraser head pointing stick. At \$5,949, the 6.8-pound Ascentia is less expensive than IBM's Editors' Choice-winning ThinkPad 755C, yet is also built around a stunning 10.4-inch active-matrix

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New Notebooks

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ASCENTIA 900N: *AST combines good performance with an attractive look.*

color screen. In fact, the only thing the Ascentia lacks is built-in sound, a feature we've come to expect from flagship notebooks.

This dramatic makeover didn't cause AST to ignore the Ascentia's architecture, which delivered excellent all-around performance on our suite of benchmark tests. The unit we tested used Intel's 75-MHz 486DX4 processor and came equipped with 8MB of RAM, a 510MB hard disk, and a Type III PCMCIA slot that can also accommodate a pair of Type II devices.

Quite simply, the Ascentia outperformed the other four notebooks in this review. The most remarkable aspect of the Ascentia is its 10.4-inch Hitachi active-matrix color display. Aided by Western Digital's RocketCHIP graphics controller, the Ascentia delivered excellent Graphics WinMark and Winstone 94 scores (6.5 million pixels per second and 40.1, respectively). The Ascentia's nickel hydride batteries and power management system allowed the unit to run for a remarkable 4 hours 35 minutes.

Another new feature on the 1.6-by-11.5-by-8.5-inch Ascentia is an easy to use and responsive

SmartPoint mouse substitute that is built into the notebook's full-size keyboard; this device is a welcome improvement from

AST's bulky clip-on trackball. The Ascentia has a lot going for it including a stunning color display, top-notch performance, and—given its configuration—a reasonable price tag.

► **AST Ascentia 900N.** List Price: \$5,949 with 8MB RAM, 510MB hard disk. AST Research Inc., 16215 Alton Pkwy., P.O. Box 57005, Irvine, CA 92718. 800-876-4278,

714-727-4141; fax, 714-727-9355.

Circle 428 on reader service card

ThinkPad 510Cs: IBM's New Blueprint

There's no question that if you had about \$7,000 to spend and you wanted a full-featured notebook, the IBM ThinkPad 755C would be at or near the top of your wish list. But what if you wanted something smaller, were willing to use an external floppy disk drive, and didn't have a king's budget? Is a ThinkPad out of the question?



THINKPAD 510Cs: *IBM colorizes its subnotebook with a passive-matrix screen.*

No. At a very competitive \$2,699, IBM hopes its new ThinkPad 510Cs redefines what you can expect from a color subnotebook.

Working on the assumption that subnotebook buyers aren't willing to pay a premium for an active-matrix color screen, the 1.6-by-10.1-by-7.2-inch 510Cs weighs 4 pounds and has a 7.8-inch passive-color display. The small size of IBM's passive-color screen actually helps the colors seem more vibrant. Our test unit had 8MB of RAM, a 200MB hard disk, and a Type II PCMCIA slot. The 510Cs' keyboard does not feel cramped, as many subnotebook keyboards do, and the system includes the built-in TrackPoint II mouse substitute that everybody is now copying.

Our benchmark tests found the 510Cs—outfitted with IBM's 3.3-volt 486 BL2/50 processor—to be an acceptable but not exceptional performer. The system didn't stun us in any particular test category, though its Graphic WinMark score of 4.5 millions of pixels per second is quite good for a system with a passive-matrix color display. The 510Cs' battery time of 3 hours 14 minutes was adequate, but a little disappointing in view of the 7.5-hour battery time turned in by the monochrome ThinkPad 500 earlier this year (see "Small Wonders" March 19, 1993).

If you are working within a budget and your goal is to minimize weight without having to sacrifice color, it pays for you to take

a look at IBM's ThinkPad 510Cs.

► **IBM ThinkPad 510Cs.** List Price: \$2,699 with 8MB RAM, 200MB hard disk. IBM, Route 100, Somers, NY 10589; 800-722-2227, 914-766-1900.

Circle 429 on reader service card

Versa S/50C: NEC Goes Light

NEC takes a different tack playing the subnotebook game. With the introduction of its Versa S series of portable computers, NEC seems to be taking a

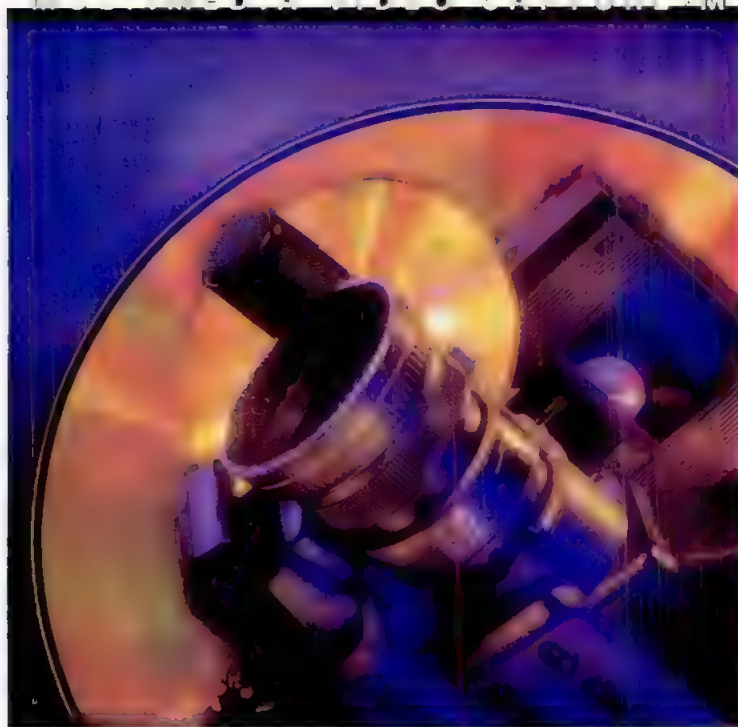


VERSA S/50C: *NEC's five-pound active-color portable sets a new class of computing.*

no-compromise approach that incorporates a 9.5-inch active-matrix TFT color display into the 5-pound, \$3,899 Versa S/50C, which uses an external floppy disk drive. Monochrome and dual-scan color versions are available at a lower cost and weigh less.

When compared with other subnotebooks, the 1.6-by-10.8-by-8.3-inch Versa S is a bit heavy, but it also feels most like a full-size portable. The Versa S's 9.5-inch active-matrix color screen is more than a full inch larger than the Toshiba T3600CT's active-color display (see review) and nearly 2 inches larger than IBM's. In addition, its keyboard is more comfortable to use than the IBM's or Toshiba's, and unlike the T3600CT or the

Continues on page 38



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CIRCLE 127 ON READER SERVICE CARD

First Looks

New Notebooks

CONTINUED FROM PAGE 36

510Cs, the Versa S has a Type III PCMCIA slot. The others make due with a Type II.

The Versa is equipped with NEC's SurePoint mouse substitute, which is similar to IBM's TrackPoint II but not as easy to use. The actuation buttons are located on a wrist rest, but the positioning takes some time to get used to.

The Versa uses Intel's 3.3-volt, clock-doubled 50-MHz 486DX2 processor; the system we tested had 8MB RAM and a 260MB hard disk. Overall test results were in line with other 50-MHz systems tested. The only disappointment was the Versa's battery life score of 1 hour 51 minutes. NEC doesn't like to call its Versa S a subnotebook. And in all fairness, NEC really has created a new class of notebook: A full-featured, lightweight, portable computer that, if successful, will help redefine the what a notebook should be.

► **NEC Versa S/50C.** List Price: \$3,899 with 8MB RAM, 260MB hard disk. NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-632-4636, 508-264-6199.

Circle 430 on reader service card.

Toshiba Portégé T3600CT Toshiba Satellite T2400CT

Toshiba fills in its extensive notebook product line with the introduction of two new portables: The \$4,799 Portégé T3600CT, which is to subnotebooks what the IBM ThinkPad 755C is to full-featured portables, and the \$3,900 Satellite T2400CT, which adds optional audio to the company's value-priced line.

It's expensive, but the Portégé is the state-of-the-art in under-5-pound portable com-

puting. There are no subnotebooks currently available that are as well designed as the Portégé, nor are there any that can match it on the two most important subnotebook factors: portability and battery life.

Toshiba outfitted the Portégé with lithium-ion battery technology, which helped the system achieve a stellar battery life of 6 hours 40 minutes. This result seems even more fantastic when you factor in the Portégé's power-hungry active-matrix color screen.

Equally impressive are the weight and size of the Portégé. It weighs 4.4 pounds and its dimensions—1.8- by 9.9- by 7.9-inches—make it very easy to take even on day trips. With the Portégé, Toshiba has made one of the most aesthetically pleasing notebooks around. And this beauty translates into function-

ality because the Portégé is as much a pleasure to use as it is to look at—from its form-fitted AccuPoint pointing stick mouse substitute to its comfortable keyboard and its brilliant 8.4-inch active-matrix display. The fact that the unit achieved good scores for a 50-MHz 486DX2 only makes it more irresistible.

With the totally redesigned Satellite T2400CT, Toshiba is going after the other end of the market: those who need a full set of features but don't have the budget. The 6.5-pound, 2.2- by 11.7- by 8.7-inch T2400CT includes an optional sound card and a built-in SCSI adapter, but in terms of value, it doesn't measure up very well in comparison with many of the 70 other systems that we evaluated in this issue. Toshiba designed the T2400CT to look like an overgrown T3600CT, but regrettably, the 8.4-inch active-matrix screen didn't grow along with the rest of the unit.



SATELLITE T2400CT: A nice redesign that adds sought-after features.

The 50-MHz, 486DX2-equipped T2400CT performed adequately on our benchmark tests, but it did nothing that really caught our attention—although its battery performance time of 3 hours 51 minutes is impressive. Overall, however, the T2400CT failed to distinguish itself on our performance tests, and certainly didn't distinguish itself from the rest of the crowd.

► **Toshiba Portégé T3600CT.** Estimated price: \$4,799 with 8MB RAM, 250MB hard disk.

► **Toshiba Satellite T2400CT.** Estimated price: \$3,899-\$4,099 with 8MB RAM, 250MB hard disk. Toshiba America Information Systems Inc., P.O. Box 19724, Irvine CA 92713; 800-334-3445, 714-583-3000; fax, 714-583-3800.

Circle 341 on reader service card



PORTÉGÉ T3600CT: The state-of-the-art in subnotebook technology from Toshiba.



Benchmark Tests: New Notebooks

The only clock-tripled notebook we tested, the AST Ascentia 900N, uses a 75-MHz 486DX4 and outperformed the other 50-MHz notebooks on most of our benchmark tests. The most exceptional score we saw was the Toshiba Portégé T3600CT's Battery Life score of 6 hours 27 minutes. To see how these notebooks stack up

against the rest of the competition, see the benchmark test results in this issue's "Spectrum of Choice." Higher scores represent better performance.

We used PC Magazine Labs' PC Bench 8.0, WinBench 4.0; Winstone 94, Version 1.0; and 2Digit 2.0 to measure the performance of these notebooks

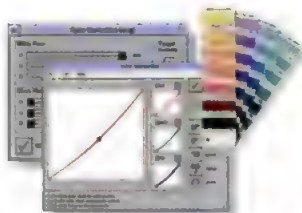
	Winstone (score)	Processor (score)	Graphics WinMark (millions of pixels per second)	Video (score)	Disk WinBench (score)	Disk (score)	20%mark (score)	Battery Life (hours: minutes)
AST Ascentia 900N (DX4/75)	40.1	30.5	6.8	3,470	774	657	497	4:35
IBM ThinkPad 510C (IBM BL 50)	25.8	18.8	4.5	3,426	456	697	331	3:14
NEC Versa S/50 (DX2/50)	30.0	25.9	3.2	3,602	590	871	441	1:51
Toshiba T2400CT (DX2/50)	30.3	26.9	3.6	2,448	857	860	437	3:51
Toshiba T3600CT (DX2/50)	31.8	26.7	3.6	2,449	820	825	431	6:27



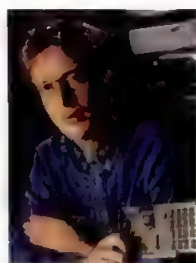
Lynne - Graphic Designer :

"Color. I need rich beautiful colors in fine detail. The colors on the screen must match the printer. And speed. When I make a change, I want it on the screen instantly. Nothing less will do. "ATI's GRAPHICS PRO TURBO gives me the

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Precise color calibration



Doug - Power User :

"Only ATI's GRAPHICS PRO TURBO met MY spec! I wouldn't settle for less for my new Pentium computer. It is not just the fastest Windows performer overall: 42M Winmarks with 256 colors and 28M Winmarks in true color. It also

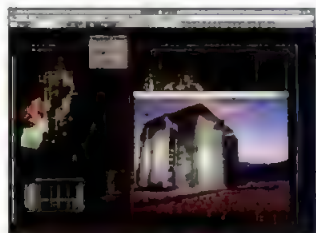
comes loaded with Windows features, such as the ability to instantly switch color and resolution without leaving Windows, and FlexDesk+, an advanced software panel to control color, resolution, desktop and motion video acceleration. ATI's GRAPHICS PRO TURBO has a complete set of drivers for all the other operating systems."



Harry - Architect :

"Detail. My drawings and models have incredible detail. I need resolution so sharp, I could cut my finger on it. Performance and color are critical in both DOS and

Windows. And, I want a graphics card that will reduce eye strain."ATI's GRAPHICS PRO TURBO gives fast true color at high resolutions under both DOS and Windows. It comes with fast and feature rich drivers for my CAD applications. After I'm done, I can unwind the day with an exciting game. Only fast DOS performance makes that possible."



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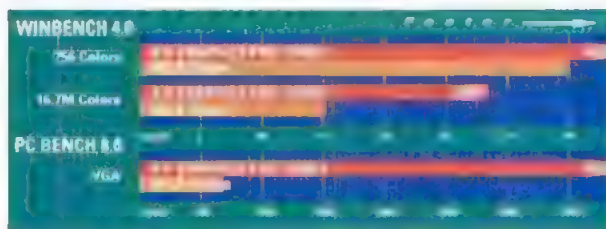
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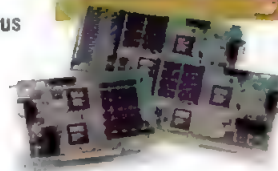
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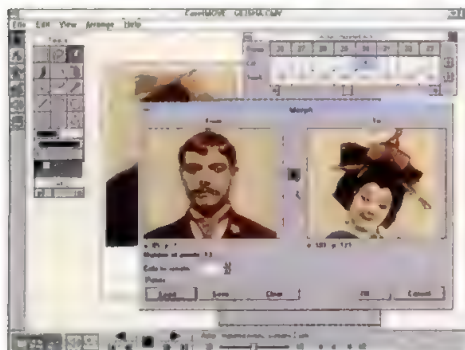
CorelDRAW 5

CONTINUED FROM PAGE 35

best demonstrated by the absence of Corel Ventura, which wasn't ready for prime time and so is not included. Instead, there's a voucher for a copy of Ventura when it is ready.

Once again, CorelDRAW pushes the envelope of illustra-

when you work in CorelChart, you assign fill and line styles using CorelDRAW-style dialog boxes and roll-ups. If, for example, you drag an object directly from CorelDRAW to Corel-Photo-Paint, OLE links will take care of transferring the object and creating a new file; Corel-Photo-Paint is smart enough to rasterize the vector drawing on the fly.



MORPH: CorelMove's new morphing feature transforms one image into another by blending key points from the source to the target.

tion programs. The Lens feature allows you to apply one of eight different photographic filters, such as colored transparency, heat map, brighten, or magnify, to an object in your drawing.

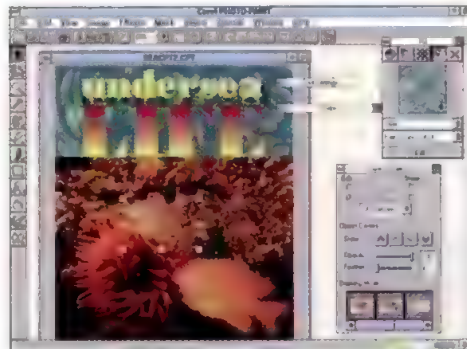
CUSTOM FILTER TOOLS

The addition of object layering (which allows you to stack, rearrange, and apply filters to individual raster objects within a composition) and vastly improved selection tools makes this program a strong photo montage and image-editing tool. For example, you can transparently switch between a number of different tools—including color selection, a paintable mask, and Bezier-curve outlines—to edit a selection area. In addition, CorelPhoto-Paint now supports the Adobe Plug-In specification, which means that you can add third party filters (like Aldus Gallery Effects or HSC Software's Kai's Power Tools for Windows) to supplement the supplied filters.

The synergy between the various programs in the Corel suite is also on the rise. Now

A color management system called Candela Color Management is included. It works in a manner similar to better known color management systems, such as Kodak Precision Color or EFIColor from

Electronics for Imaging. Candela stores information about the color space and capabilities of your monitor, printer, and scanner for more accurate previews. The result is consistent color display across all of the applications in the Corel suite—something that



SIMULATE: CorelPhoto-Paint can now layer objects, complete with a roll-up to the control stacking order, transparency, and feathering of—in this case—two fish and three text objects.

standalone graphics products don't offer. On the downside, Candela currently doesn't supply accurate color previews and gamut alarms in the color-picker dialog boxes. This means that you won't know if the colors you are mixing are out of the accept-

■ One from Column A...

Corel's marketing strategy is looking more and more like an old-fashioned Chinese restaurant menu: Either choose a complete meal composed of one selection from Column A, one from Column B, and so forth; or subsist on à la carte purchases. In product shopping as in dining, you shouldn't just compare prices. Find out if the less expensive (and admittedly less powerful) versions of these programs have the features to satisfy your needs.

With so many versions of the product to support, Corel is unsurprisingly offering some free technical help. With each purchase, you receive a credit for one 15-minute technical-support call. If you need additional support, you can buy one credit for \$25, five for \$100, or ten for \$175.—L.S.

Product	Disk price	CD price
CorelDRAW 5.....	\$895	\$695
CorelDRAW 4.....	\$595	\$395
CorelDRAW 3.....	\$199	\$149
Corel Ventura 5.....	\$595	\$495
Corel Ventura 4.2.....	\$249	\$229
CorelPhoto-Paint.....	\$249	\$199

able range until you return to your working drawing.

Our preliminary tests revealed some unacceptable color shifts when we converted RGB colors to CMYK. The screen preview is good enough to alert novice users to potential printing problems, but advanced users (and service bureaus) will need

to explore Candela's customization options to control separation parameters. Other improvements bring CorelDRAW on a par with existing graphics programs. The PowerClip function lets Corel create the same masking or clipping paths that are available in some competing products.

For pure fun you can't beat the morphing effect in CorelMove, which creates multiple-frame animations by blending between two bitmap pictures. And saving your CorelMove creations in standard formats (such as .FLC, .AVI, and QuickTime for

Windows) means that you can incorporate them into a wide variety of presentations. We were disappointed with the obvious dithering in the morph and with the artifact introduced into the exported Intel Indeo compressed .AVI file (though Corel's own RLE compression worked just fine).

Although this review can't truly be complete until Corel Ventura is released later this year, the applications we tested successfully walk the fine line between high-end illustration software—which includes robust separation and printing functions—and easy-to-use graphics tools for business users.

► **CorelDRAW 5.** List Price: \$895; CD-ROM version, \$695; upgrade from CorelDRAW 4: disks, \$249; CD-ROM, \$199; upgrade from CorelDRAW 3 or earlier: disks, \$449; CD-ROM, \$349. Requires: 8MB RAM (16MB recommended), 49MB hard disk space, Microsoft Windows 3.x, SVGA graphics adapter and digitizing tablet recommended. Corel Corp., 1600 Carling Avenue, Ottawa, Ontario K1Z 8R7, Canada. 800-836-3729, 613-728-8200; fax, 613-761-9176.

Circle 425 on reader service card



Paul - Manager/Parent :

"I needed a performance boost for my PC. It took a long time for my charts and presentations to appear on the screen. The colors were flat and limited. And my son's games ran slowly. But, I wasn't ready to buy a whole new system.

"Fortunately, I got great advice.

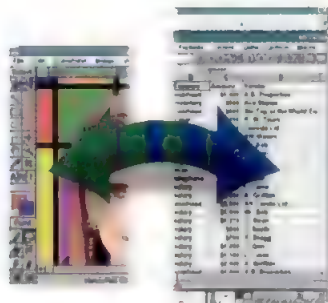
*For just \$299**, I got ATI's GRAPHICS XPRESSION. It revived my whole system.*

"My friend had one. Windows snapped open quickly. Charts popped up on his screen. The blazing speed, 37M Winmarks, was incredible. He said it offered best value for price/performance. And the improvement in color graphics and detail were most impressive.*

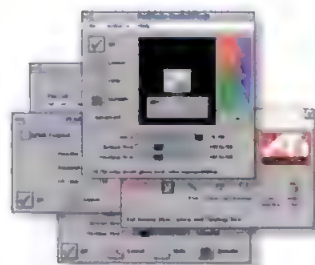
"Then, he showed me the features. WinSwitch allowed him to switch between true color mode or high resolution mode without exiting Windows. And ATI's FlexDesk+ software gave him total control over color, desktop size, resolution and even motion video acceleration.

"Finally, he told me it was the only affordable 64-bit accelerator for my ISA system. I rushed out to buy one. Installation was easy. There were no switches to set and the software guided me through the installation process. And I was amazed, it even came with a complete set of drivers for Windows, Windows NT, OS/2, CAD and DOS.

"Best of all, my PC now runs much faster in Windows, DOS and games. I almost never see that Windows hour-glass. GRAPHICS XPRESSION. At only \$299, it is still great advice."



WinSwitch changes color and resolution without leaving Windows



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33 Commerce Valley Drive East
Thornhill, Ontario Canada L3T 7N6
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- Full acceleration in 256 to 16.7M colors
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- Up to 75Hz refresh rate
- Available for ISA, PCI or VESA Local Bus
- 2MB DRAM memory
- Five year limited warranty
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PCs

Innovative Compaq System Points Toward the Future

BY DON WILLMOTT

Compaq has put some truly creative thinking into the design of its new top-of-the-line Deskpro XL. Poised to replace the Deskpro M, the new system is designed to work equally well on the desktop or beside the desk, even with a CD-ROM drive installed. Its innovative Vocalyst keyboard features a built-in microphone, speaker, and mouse port. With PCI, Fast SCSI, and above-average upgradability, the Deskpro XL delivers performance, though its price may give you pause.

There are four Deskpro XL models. We received a 60-MHz Pentium with 8MB RAM (the system is expandable to 144MB; we tested with 16MB), a 256K cache, and a 270MB IDE hard disk for evaluation. The system is also available with a 50- or 66-MHz DX2 or 66-MHz Pentium processor. Surprisingly, unlike some of its competitors, Compaq hasn't released a 90-MHz Pentium model yet.

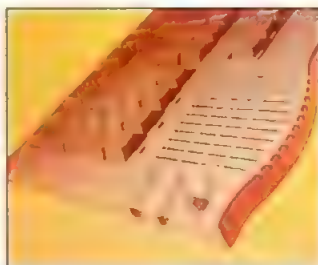
Compaq rarely has the lowest-priced system on the block, and the Deskpro XL is no exception. Our 60-MHz Pentium test system had an estimated selling price of \$3,299 without a monitor, while a 66-MHz DX2 model with 8MB RAM and a 270MB hard disk costs about \$2,799 without a monitor. A CD-ROM drive adds about \$200 to the price, and Compaq has two monitor offerings: a 15-inch model for \$499 and a 17-inch model for \$999.

PCI AND FAST SCSI

Inside, you find a multitude of expansion possibilities; one EISA/PCI,



UP OR DOWN: The Deskpro is designed to be used as either a desktop or a tower.



SPEAK UP: The Vocalyst keyboard has an integrated microphone.

one PCI, and three ISA expansion slots; five drive bays; 32-bit Fast-SCSI-2 integrated on the motherboard; and a built-in Ethernet adapter.

The Matrox-based QVision 2000 graphics subsystem (stan-

dard on the 66-MHz DX2 and Pentium models, optional on the 50-MHz model) offers 1,280-by-1,024 resolution with 256 colors and 2MB VRAM, and in benchmark testing it proved to be extremely fast in Windows-based tests but rather slow on the PC Bench Video test, which focuses on DOS operations. The Matrox chips are clearly designed with pumping graphics through the pipe in mind, and that they do well.

PNP READY

Both the processor and the video chips are on removable cards so that future upgrading is easier. The Deskpro XL also supports the emerging Plug and Play standard.

One other nice design touch: The fan, which is positioned right by the processor, is wonderfully quiet.

In benchmark testing, the Deskpro XL had no trouble beating the average performance of all the 60-MHz Pentiums that PC Labs has previously tested. The system's Winstone score was a strong 77.8, and its graphics accelera-

tion helped to achieve a good Graphics WinMark result of 25.9 million pixels per second.

The cleverly designed (and proprietary) Vocalyst keyboard includes not only a microphone, a microphone jack, and a surprisingly good speaker (with thumb wheel for volume control), but also a mouse port. Compaq, a pioneer in the realm of business audio, is convinced that the world is ready to add sound annotation to documents. If you're not so sure and you don't see yourself blending sound into your business life, you'll be paying a premium for gadgetry you won't be using, but the integration merits praise. After all, you end up with far fewer cables criss-crossing your desk.

PUT IT ANYWHERE

The Deskpro XL chassis is finished on all sides, and it comes with a stand, so it's as usable on the floor as a tower as it is on the desk. Wraparound status lights are visible in either position, and the caddyless CD-ROM drive (which we saw in a prototype unit; there wasn't one included in our evaluation unit) works fine vertically, though it's slightly awkward to insert a CD-ROM disk that way.

The Compaq Deskpro XL is a winning combination of thoughtful, forward-looking design and above-average performance. If you have a few hundred extra dollars in your budget, you will, in fact, get what you pay for. Here's hoping that Compaq hurries to add both 90-MHz and 100-MHz Pentium-based models to the family.

► **Compaq Deskpro XL.** Estimated selling price: \$3,299 with 8MB RAM, 270MB hard disk. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518; 713-378-8820; fax, 713-378-1442.

Circle 417 on reader service card

Benchmark Tests: Compaq Deskpro XL

The Compaq Deskpro XL is a strong Pentium performer, easily surpassing the average 60-MHz Pentium performance level on the Winstone and PC Bench processor tests. The only low score it earned was

for DOS video, which won't be a major concern for Windows users. Higher scores represent better performance.

We used PC Labs' PC Bench 8.0; WinBench 4.0; and Winstone 94, Version 1.0, to measure performance.

	Winstone (score)	Processor (score)	Graphics WinMark (millions of pixels per second)	Video (score)	Disk WinMark (score)	Disk (score)	DOSmark (score)
Compaq Deskpro XL (60-MHz Pentium)	77.8	71.1	25.9	573	1,260	1,479	536
60-MHz Pentium average	73.3	69.5	17.3	2,244	1,214	1,377	815



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CIRCLE 292 ON READER SERVICE CARD

Flowcharting

ABC ToolKit: Flowcharting, The Next Generation

BY J.W. OLSEN

Brace yourself before you run Micrografx's new ABC ToolKit for the first time. Did you just pay \$895 only to get the \$495 ABC FlowCharter by mistake? After all, the only difference you see is two additional buttons.

Don't worry. You'll quickly discover capabilities in ABC ToolKit that take flowcharting to a whole new level.

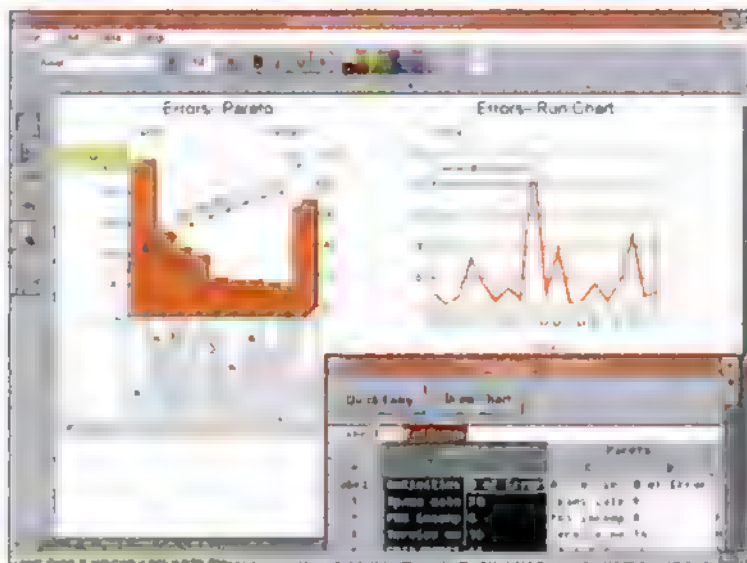
The program's two independent modules—ABC ProcessAnalyzer and ABC DataAnalyzer—do flowcharting, but they can also assign data to flowchart objects and even manipulate and chart data. Together, they go beyond a flowchart's ability to visualize a corporate structure by quantifying and analyzing the strengths and weaknesses of its individual processes, and they identify possible solutions by exploring what-if scenarios that would normally require a spreadsheet.

For example, say a simple company flowchart contains objects for order entry, fulfillment, and accounts receivable, and each object is assigned time and cost data. This company has 20 divisions, each of which maintains its own flowchart and accumulates data. With ToolKit's ability to "migrate" data totals between successive levels of subcharts, you can roll up totals and analyze the whole company's performance. Later you can manipulate this actual data through what-if replacement of values and chart the results, as in a spreadsheet. Process weaknesses become clearer as you visualize time bottlenecks or

uncover unusually expensive operations.

START WITH A CHART

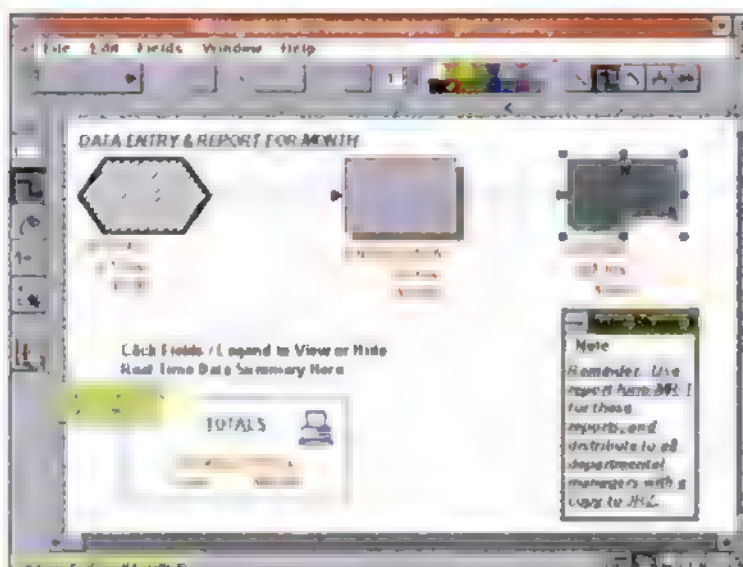
You begin by creating a conventional flowchart or importing one from ABC FlowCharter. In fact, if you're familiar with ABC FlowCharter 3.0 (First Looks, April 26, 1994), you already know ABC ProcessAnalyzer's basic flowchart features: 25 palettes of flowchart objects; drag-and-drop to add objects; user-friendly functions to manipulate connector lines, embedded graphics, spreadsheet cells, animation, and sound icons; and pop-up note windows.



DATA ANALYSIS: ABC ToolKit's DataAnalyzer displays assigned data in editable worksheet and multiple chart formats.

Within ProcessAnalyzer, you then assign an unlimited number of data fields to flowchart objects and connector lines, each with a name, type, format, and accumulation method.

Field types include text, time, date, currency, percentage, and general numbers. Most field types offer alternative assignable formats—such as dollars only or dollars and cents—for currency. Accumulation methods affect later calculations.



DATA TRACKING: Assign notes and data to objects in ABC ToolKit's ProcessAnalyzer, with real-time totaling and averaging displays.

Among nine available methods are sum, mean, median, minimum or maximum value among all objects, and difference between highest and lowest values. As you enter data for objects and lines, ProcessAnalyzer tracks these cumulative results.

You see the true strength of such data when you link objects to subcharts that can go a remarkable 36,000 levels deep. By properly assigning field names among levels, the summary data merges while migrating to upper levels.

ProcessAnalyzer's data tracking has a glaring omission, however. All data at the lowest level—whether in a standalone or linked flowchart—must be manually entered. Though you can display external data within a flowchart via OLE 2.0, ToolKit doesn't import external data into its own data-tracking stream. This invites data-entry errors and adds a manual step that would benefit a lot from direct linkage.

You use ABC DataAnalyzer to develop statistical charts that help you find ways to improve

your corporate processes.

You begin by opening a spreadsheetlike window and entering data. The data can come from existing files, including DataAnalyzer's own .DAT format, or from spreadsheets such as Lotus 1-2-3 and Excel. Unfortunately, using external

formats is a somewhat cumbersome trial-and-error experience.

With data entered, you select the cells you want to chart and the desired chart type. Available chart types include Pareto, histograms, pie, control, run (trend), and scatter diagrams, providing diverse ways to view the same data. You can also enhance charts with automatically generated legends and tables, add text, and apply special effects.

THE FINAL ANALYSIS

ABC ToolKit integrates data analysis with today's most powerful, easy-to-use flowchart design software. It is, however, only a first step. Missing from this high concept is transparent movement of data. You should be able to link external data directly into ABC ProcessAnalyzer's data stream without manual entry. You should be able to effortlessly move from ProcessAnalyzer into DataAnalyzer's worksheet cells. And you should be able to directly load such worksheets into your spreadsheet program.

Current ABC ToolKit features are solid and a delight to use. The program is worthwhile for progressive-thinking companies seeking process management capabilities now. At the same time, it has ample room in which to mature.

► **ABC ToolKit 1.0.** List price: \$895. Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1 or later. Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; 800-676-3110, 214-234-1769; fax, 800-994-6475.

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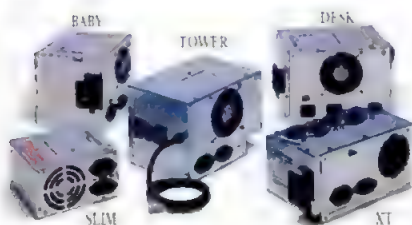
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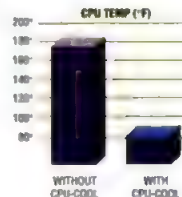
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CIRCLE 080 ON READER SERVICE CARD

Scanners

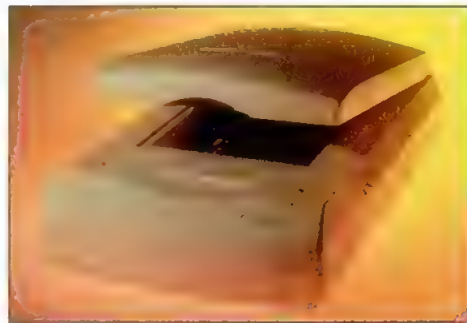
Microtek and UMAX: More Bits for More Bucks

BY LORI GRUNIN

When is a 24-bit scanner not a 24-bit scanner? When it's UMAX Technologies' 30-bit PowerLook (\$3,495) or Microtek Lab's 36-bit ScanMaker III (\$3,499). Targeted at demanding applications such as corporate in-house publishing, desktop publishing, graphic arts, and desktop prepress, either of these scanners can ably handle those jobs where a 24-bit flatbed system (such as the HP ScanJet IIcx) isn't good enough, but a drum scan from a service bureau isn't necessary or is too expensive.

The terminology can be a little misleading because most desktop flatbed 24-bit scanners don't really capture a full 8 bits of data per color channel because of noise; at most, they capture around 7.2 bits per channel. The PowerLook and the ScanMaker III use their wider scanning ranges to pick up more information. This leads to better quality scans, particularly with respect to tonal values, and allows capture of a full 8 bits per channel. The result is images with better detail in highlight and shadow areas and greater color accuracy than that found in common desktop scanners.

Both scanners offer optical resolutions of 600 by 1,200 dots per inch (dpi), have very powerful Twain drivers, and are list priced at under \$3,500. However, the two scanners aren't really in the same league. On one hand, the PowerLook ships with a transparency adapter; Microtek's costs an extra \$699. The ScanMaker III, on the other hand, can handle up to legal-size pages; the PowerLook maxes out at letter-size paper.



POWER SCAN: Microtek's ScanMaker III provides excellent accuracy, balance, and range, but is a little on the slow side.

SCANMAKER III

Overall, the ScanMaker III is the more powerful of the two scanners, and produces images with extremely good color accuracy, color balance, and tonal range. For instance, in contrast to the 24-bit scanners we looked at in our issue of February 8, 1994, the best of which could sense 28 out of 37 gray-scale steps, the ScanMaker III picked up 35 out of 37.

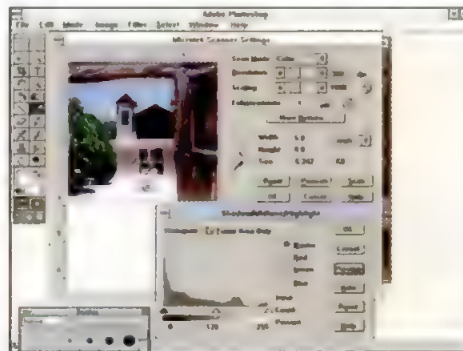
The ScanMaker III also displays extremely accurate, consistent resolvability between 320 and 600 lines per inch (depending upon the angle and relationship of the lines). The unit is acceptable on scanning speed: It took about 40 seconds to scan a 35-mm slide at 1,200 dpi and about 1 minute to scan a 4-by-6-inch photo at 264 dpi. (We tested on a 60-MHz Pentium Gateway 2000 P5-60 with 16MB RAM and a 51MB permanent swap file.)

The unit's 36-bit CCD (charge-couple-device) and good optics contribute to the tight color balance and registration, but the secret of the ScanMaker's overall success is its DCR (Dynamic Color Rendition) calibration software, which allows you to set up device

profiles for your scanner, monitor, and printer. The Twain driver then applies these profiles at scan time. The result is excellent overall color quality in traditionally hard-to-reproduce ranges, such as skin tones or neutral grays.

The Twain driver—the same

one used by the rest of Microtek's ScanMaker product line—is quite powerful. It gives you a live preview of almost every setting, which shows changes as you manipulate parameters.



DRIVEN: While not as complete as UMAX's, Microtek's Twain driver provides most of the important scan controls.

The controls include brightness, contrast, exposure, highlights, and midtones for individual channels, as well as a variety of preset gamma curves (or you can establish your own); most settings have an automatic mode as well. The driver can also apply a variety of filters—blur, sharpen, edge enhancement, and emboss—at scan time. Unfortunately, you can only set scan resolutions in 6-, 12-, or 24-dpi increments

depending upon the resolution you want.

Once it's up and running, the ScanMaker III is great; getting there isn't terribly fun, however. If the default setting doesn't work, you have to set DIP switches on the NCR-based SCSI adapter to determine an upper-memory block for it will use, and if necessary, manually exclude that memory address in your CONFIG.SYS and SYSTEM.INI files. And although the unit and transparency adapter are well made, the light source in the transparency adapter has the habit of sinking like an elevator every time you lift the lid. Finally, for the \$3,500 you're laying out, Microtek should spring for a 6-foot SCSI cable instead of the 3-foot cable included.

UMAX POWERLOOK

While not quite the heavy-hitter the ScanMaker III proved to be, the Umax PowerLook still has a lot to be proud of. It also produced images with very good

color balance and registration, although the scanner's lack of a calibration routine (other than monitor calibration) made producing good-looking images difficult; UMAX will ship color-calibration software called Magic Match sometime later this year. Clearly

the information is all there, as evidenced by the scanner's ability to pick up 34 out of 37 gray-scale steps and to produce a consistently good line-art resolvability of between 284 and 400 lines per inch (lpi), depending upon angle and relationship between them. On the other hand, the PowerLook is nearly twice as fast as the ScanMaker III, thanks to a 2MB buffer. The unit scanned

Continues on page 47

Scanners

CONTINUED FROM PAGE 46

the same test 35-mm slide at 1,200 dpi in only 30 seconds, and handled the 4- by 6-inch photo at 266 dpi in 25 seconds.

While no substitute for calibration, the MagicScan Twain driver includes all the manual controls you might need to rectify any problems that might crop up. You can set three different

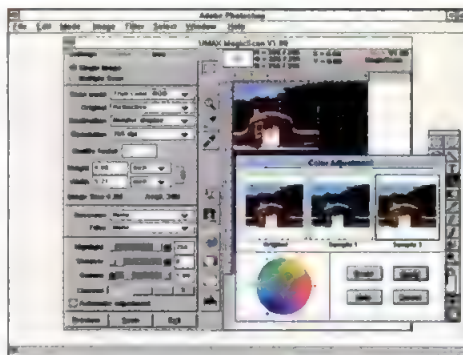
descreening levels (175, 133, and 85 lpi); apply sharpen, blur, or unsharp mask (in highlights, midtones, and shadows); set highlight and shadow points or gamma, both by individual channel; scan gray scale or line art in a single color channel; adjust hue and color balance with live previews; apply custom tonal maps; or redistribute the tonal range based on the histogram.

The MagicScan driver can also set up batch jobs to scan multiple areas of the scan bed with different parameters, such as a color slide and a black-and-white photo. While straightforward, this is an amazingly useful tool, especially in production environ-

ments, but it has one big problem: It crashes when configured to save each job to a file. The company has been unable to replicate this problem, however.

With expected street prices of around \$2,700, neither of these units is for the casual user. If you need better-than-average quality but can't afford the extra \$700 Microtek charges for the transparency adapter and don't mind a little extra work, then the PowerLook will do the job. Otherwise, the ScanMaker III is the way to go.

► **PowerLook.** List price: \$3,495. UMAX Technologies Inc., 3353 Gateway Blvd., Fremont, CA 94538; 800-562-0311, 510-651-



LIKE MAGIC: MagicScan, the TWAIN driver that ships with the PowerLook, lets you manipulate all the scanning parameters necessary for prepress work.

8883; fax, 510-651-8834.

Circle 426 on reader service card

► **ScanMaker III.** List price: \$3,499; optional transparency adapter, \$699. Microtek Lab Inc., 3715 Doolittle Dr., Redondo Beach, CA 90278; 800-654-4160, 310-297-5000; fax, 310-297-5050.

Circle 427 on reader service card.



QUICKIE: UMAX's PowerLook scanner was easy to install and scanned quickly.

Monitors

NEC MultiSync 2V Sets The Entry-Level Pace

BY BRAD STILLWELL

Few 14-inch color monitors offer more features (such as power conservation, MPR II compliance, and digital controls) at a lower price—as little as \$355—than the NEC MultiSync 2V monitor.

The 2V is a step up from NEC's SVGA monitor, which will be discontinued, by offering higher refresh rates, power-saving features and a three-year warranty. The 2V has a maximum refresh rate of 70 Hz at 1,024-by-768 noninterlaced resolution and 76 Hz at 800-by-600 resolution.

This model meets MPR-II standards for reduced electromagnetic radiation, and is fully compliant with the Video Electronics Standards Association's Display Power Management Signaling (DPMS) standard. According to NEC, the monitor

powers-down in three stages to less than 30 watts to meet the EPA's Energy Star certification requirement.

While NEC's other value-line monitor, the 15-inch MultiSync 3V, relies on the flat-square tube that makes NEC's high-end 15- and 17-inch monitors such notable performers, the 2V uses a conventional tube. Overall, its picture lacks the characteristic sharpness and brightness of NEC's high-end monitors, and its usable screen size of 13 inches is merely average for a 14-inch display. The real difference is price: The MultiSync 2V costs less than half

as much as a comparable member of NEC's MultiSync FG display family. This puts the MultiSync 2V more in the range of budget monitors.

VISUAL CONTROL

Unlike the 3V, which relies on analog controls, the 2V combines thumb-wheels for contrast



BUDGET VIEW: The NEC MultiSync 2V monitor is an economical alternative.

and brightness with push-button controls for horizontal and vertical positioning, image sizing, and pincushioning. Although the 2V has no manual degauss-

ing control, the screen is automatically degaussed every time it is turned on.

In informal testing the display had no visible misconvergence; pincushioning effects were easily corrected with the built-in controls. When running graphics in 800-by-600 mode, however, the 2V we tested had considerable difficulty with screen regulation. In 800-by-600 noninterlaced mode, Moiré patterns were noticeable; in 1,024-by-768 mode, the Moiré effects were so distracting that eye strain was the result.

As long as users and potential buyers regard the 2V as a budget display and don't expect the top-notch image quality of NEC's high-end models, they will find the 2V a satisfactory performer at an excellent price from one of the monitor industry's market leaders.

► **NEC MultiSync 2V.** Estimated street price: \$355. NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; 800-388-8888, 508-264-8000; fax, 708-860-7973.

Circle 422 on reader service card

■ Image Editing

Picture Window: Digitize, Edit, And Print Color Photos in a Snap

BY DANIEL GROTTA

Kodak's Photo CD system is an interesting and relatively inexpensive way to turn your snapshots into digital files that your computer can read. But unless you're prepared to spend big bucks on a high-powered PC, a decent color printer, and pricey imaging software, how are you going to make custom Photo CD prints on paper?

That's the question Digital Light & Color answers with Picture Window, Version 1.0, a relatively easy to use \$199 Windows program that integrates effective, well-thought-out photo-editing software with Photo CD and printmaking services. You send your exposed film or pre-existing transparencies or negatives to an Atlanta firm to be scanned into Photo CDs (at 95 cents per image), use Picture Window to edit those images, and then mail the finished files to a Massachusetts service bu-

apply all kinds of special effects to otherwise boring photos.

Installation is quick; the program makes no changes to your CONFIG.SYS or AUTOEXEC.BAT files, and for convenience, all DLL files are placed in the Picture Window directory rather than in the Windows directory.

HIGH-END EDITING TOOLS

The three menus most involved in Picture Window's photo editing are Transformations, Mask, and Tools.

Transformations contains most photo-editing commands that control or change the picture's color, gray-scale values, dynamic range, shape, size, orientation, and general composition. Among the most useful is Filter, which emulates camera filters by adjusting the exposure and color balance or creating a double exposure. Picture Window also has a small handful of special-effects tools such as Emboss, Find Edges, Noise, Tile, and Difference.

Masking, the most important tool in image-editing, defines how much control

you'll get over all the other tools and commands. Picture Window's masks are remarkably powerful and diverse. In fact, it offers more ways to create a precise mask than many much larger and more expensive programs.

The Tools menu focuses on those commands that can change individual pixels and



LIGHT BRIGHT: Picture Window corrects exposure values in a number of ways, including with this slider.

areas, such as Paint, Clone, and Dodge and Burn (which lightens and darkens individual areas). While these tools aren't as extensive as the Transformations section, you can adjust the radius, transparency, and softness, as well as the gray-scale calculations. You can set undo levels of none, one, or multilevel, as dictated by your needs and your system's memory limitations. Unfortunately, all the brushes are the same shape: round.

Every dialog box has a full-size preview window you can enlarge and zoom into. In addition, you can set the preview to update either automatically or only when you want. All changes you make to a picture through a command dialog are applied to a new file, leaving the original image intact. This means you can return to the archived original picture at any time in the editing process. The one drawback is that it doubles

the amount of memory you'll need for storing images.

FROM START TO FINISH

The difference between Picture Window and a full-function image-editing program is that the only way you can get output from Picture Window is via Windows printing or from the associated service bureau. There's no provision for pre-press support, but that limitation shouldn't be a frustration for the color photography hobbyists Digital Light & Color is targeting with Picture Window.

The documentation is compact, very helpful, well-written, and clearly illustrated. There are instructions for automatically saving finished images onto floppy disks in JPEG compressed format. The package includes preaddressed envelopes and software-generated forms for ordering 4- by 5-, 5- by 8-, or 8- by 10-inch color prints.

Anyone who takes photographs will feel comfortable with Picture Window. That's because the program "thinks" like a photographer. For that reason, the various interfaces may initially seem strange to users of other image-editing programs such as Photoshop or PhotoStyler, but they are intuitive and easy to learn. Despite its simplicity and modest price, Picture Window is not so much a Photoshop Lite as it is a powerful and useful tool for all but the



WARP FACTOR: The Warp transformation corrects perspective. It's interactive and you can easily preview your work.

reau for affordable, high-quality photorealistic prints (costing from \$6.95 to \$14.95 each).

Think of Picture Window as a virtual color darkroom. Suddenly, you have the power to edit all your favorite snapshots. You can change the color in your Grand Canyon photos, remove unwelcome relatives from family snapshots, and

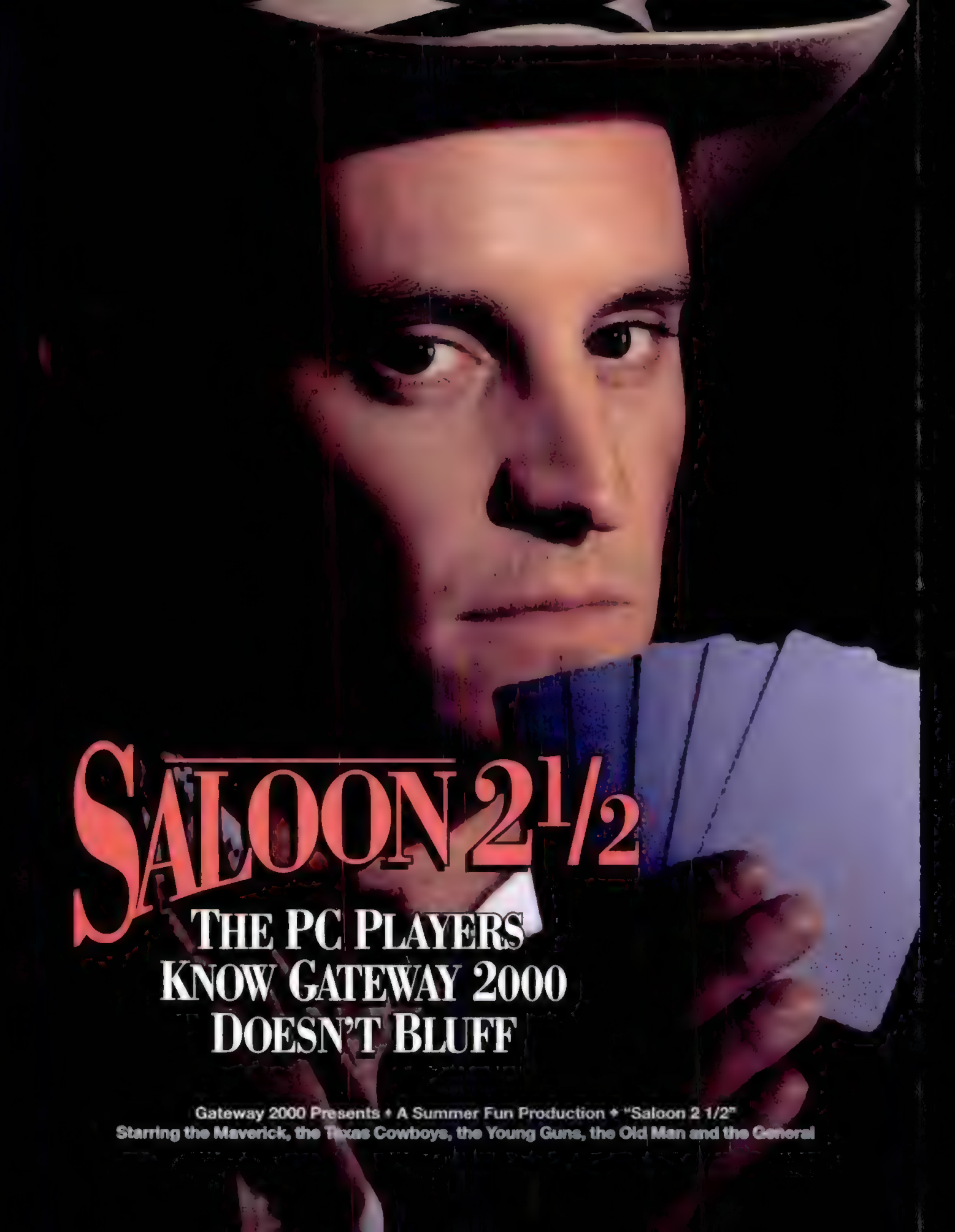
most demanding professional photo editors.

► **Picture Window, Version 1.0.** List price: \$199 (through December 31, 1994). Requires: 6MB RAM (16MB recommended), 80MB hard disk space, Microsoft Windows 3.1 or later. Digital Light & Color Inc., 36 JFK St., Suite G, P.O. Box 382908, Cambridge, MA 02238; 800-577-7090, 617-497-9027; fax, 617-576-1062.

Circle 416 on reader service card



From July 25 through July 29, you can go on-line to discuss Picture Window with reviewer Daniel Grotta and Picture Window developer Jonathan Sachs. Type GO EXEC at any CompuServe prompt.



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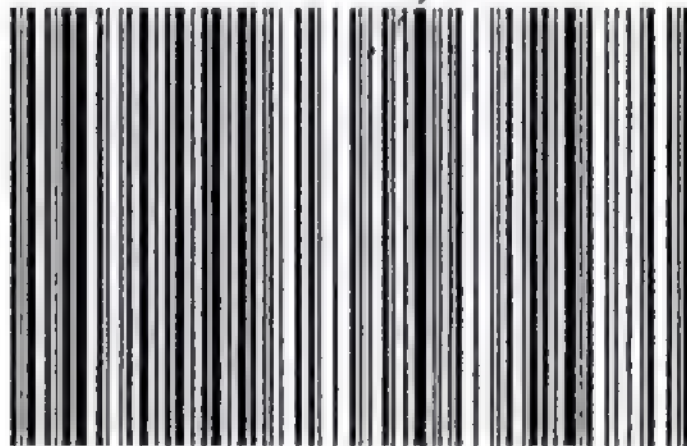
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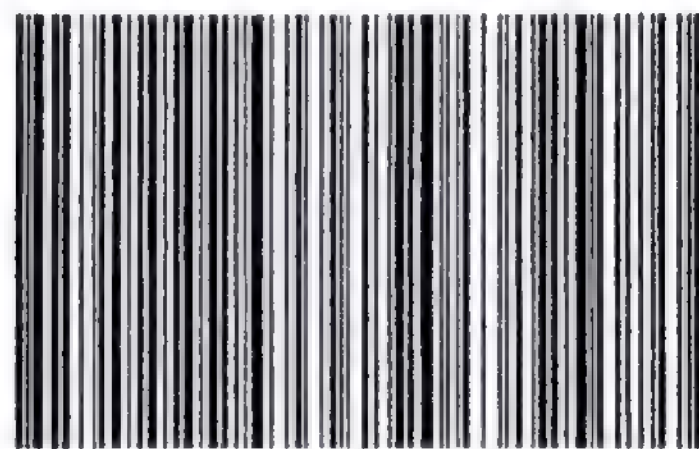
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Inverted Back

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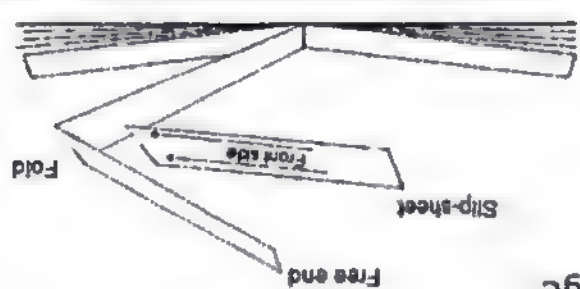


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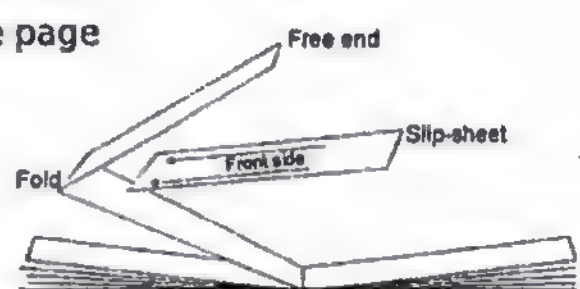
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Foldout slip-sheet

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 1. Front side touching the free page
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4. Close the page and slip-sheet



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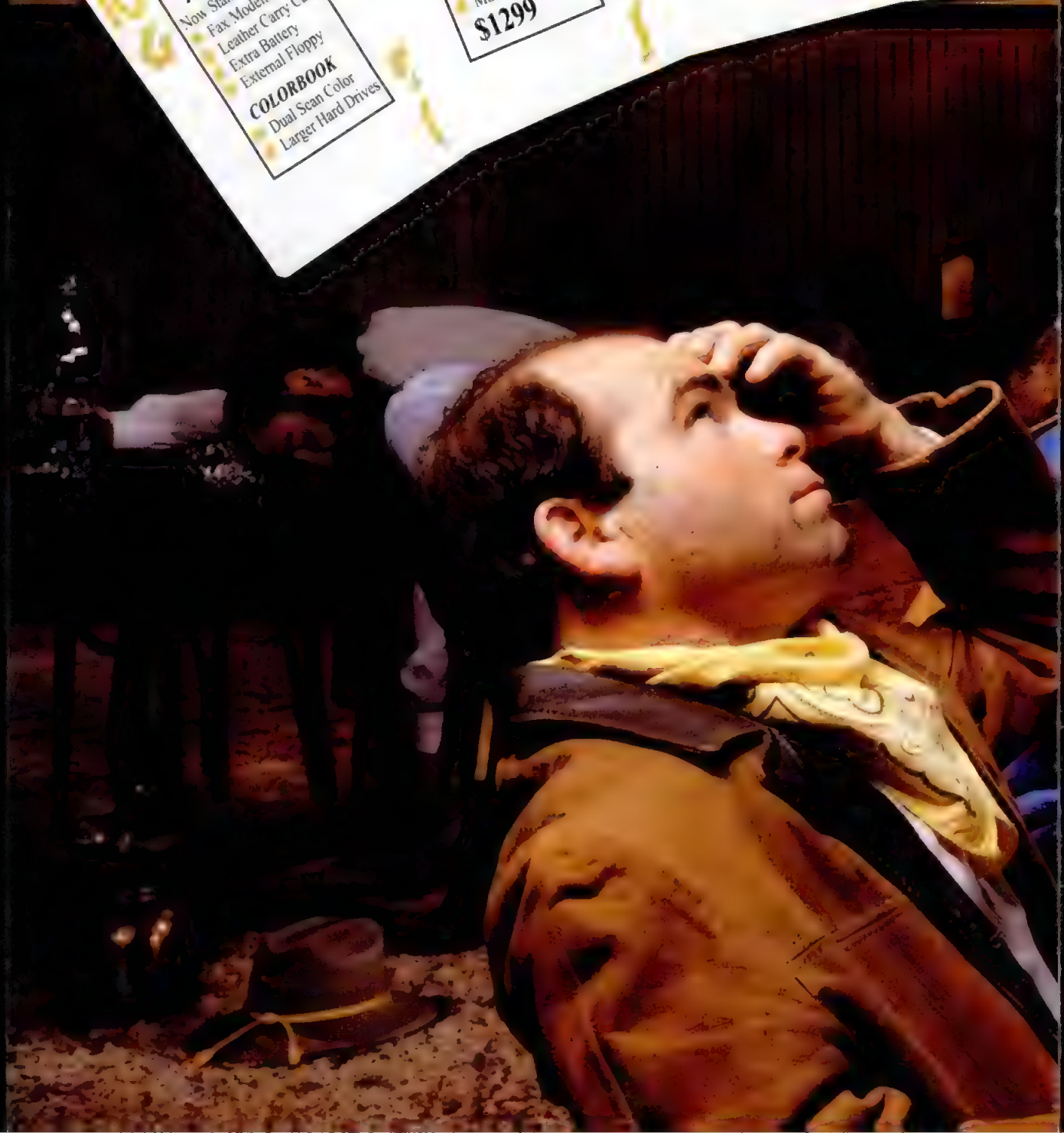
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- 2400/9600 Modem
- CD Software Kit

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- 540MB Hard Drive
- 2X CD-ROM
- 1MB PCI Graphics
- 15" CrystalScan
- MS Office Pro

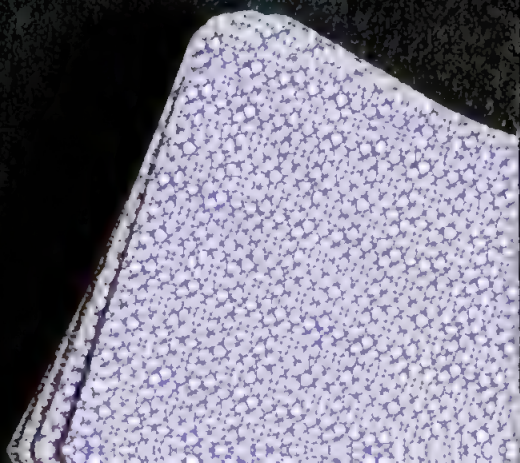
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On top of that, many Gateway desktops now include Microsoft® Office Pro™ with all of Microsoft's most popular business applications: Word, Excel, PowerPoint,® Access™ and Office Manager. It's powerful software to suit powerful systems. When you bet on Gateway, you're the winner with a hand that is unbeatable in the industry.

Speaking of the PC industry, if you've been hangin' around the PC Saloon for long, you'll recognize that this Gateway ad is a sequel to one that ran way back in the summer of 1990. Taking our cue from Hollywood, we reckoned if "Saloon" was a good ad, we might as well do "Saloon 2 1/2." What was surprising about lookin' back was seeing how many things have stayed the same.

The players around the industry poker table have changed some, but the game hasn't. Gateway's strategy is to deal you a royal flush of value: high-performance, high-quality PCs at the very best prices with old-fashioned, good service. Same as always. And although Gateway has become a Fortune 500 firm, we still think like a small, maverick company from the South Dakota frontier.

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Based on the Intel® Pentium processor, all P5 models include a PCI local bus and an enhanced PCI/IDE controller allowing your hard drive to transfer data up to twice as fast as non-enhanced systems.

Gateway's ace of spades is the P5-90 Tower model, which includes most everything a PC-poke dreams of, for \$3,999. (In the 1990 "Saloon" ad, our most advanced system was a 25MHz 486 with 4MB RAM and a 150MB hard drive for \$5,295!)

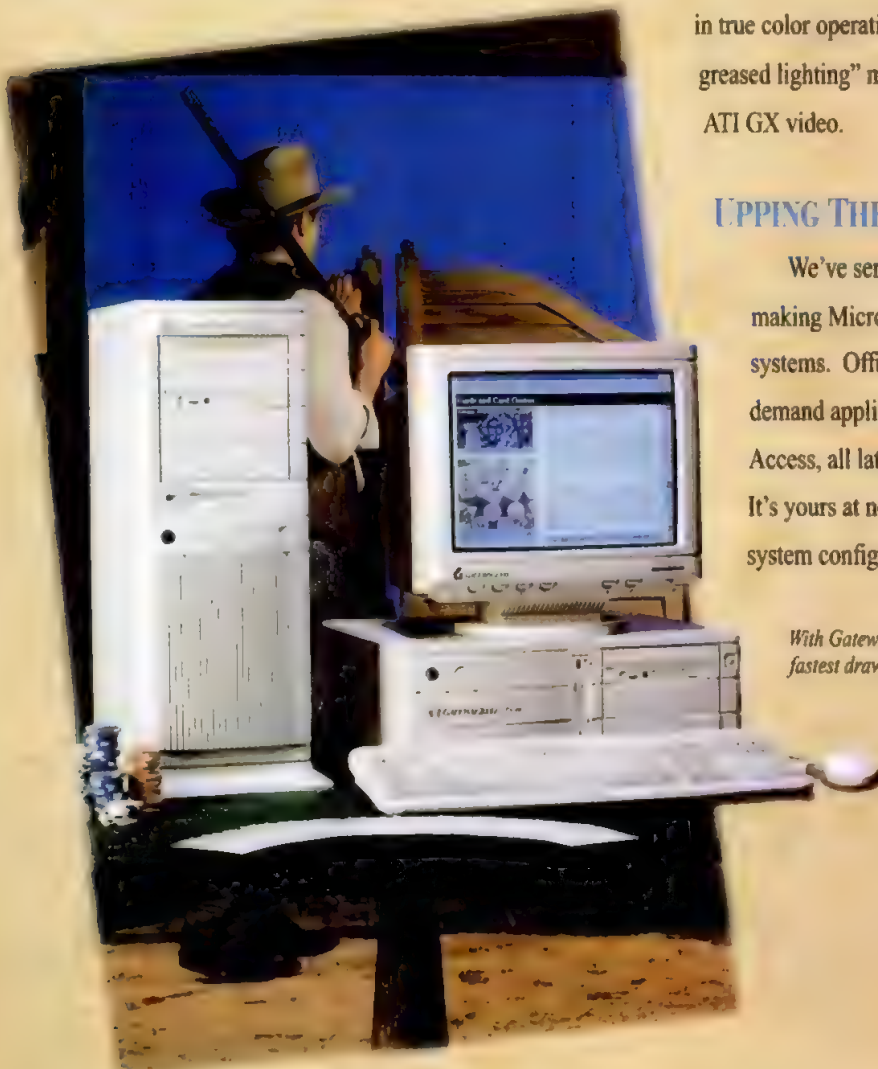
QUICK DRAW

New this month, the P5-90 Tower has an ATI GX video card for a lightning-fast draw. The ATI GX video card uses the Mach 64 graphics accelerator — one of the first and fastest 64-bit accelerators on the market — and delivers over 100 million Winmarks of video performance in Winbench 3.11 tests. This graphics accelerator is *twice as fast* as other 64-bit accelerators in true color operation. You'll understand what "faster than greased lighting" means when you try the P5-90 Tower with ATI GX video.

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We've seriously upped the ante in the industry by making Microsoft Office Pro standard on most of our systems. Office Pro includes Microsoft's most in-demand applications: Word, Excel, PowerPoint and Access, all latest versions, with a retail value of \$899. It's yours at no additional charge when you choose a system configuration with Office Pro standard.

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If you know when to hold 'em, you'll hang onto the ColorBook™ from Gateway 2000. It's a rare card in the portable game that gives you outstanding color and desktop performance at a monochrome portable price.

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Weighing less than 5.7 pounds, the ColorBook is one of the thinnest color portables around. The ColorBook comes with a powerful Intel SL Enhanced processor — 486SX, DX2 or DX4 — and gives you 256 brilliant colors in VGA mode. These ColorBooks are packed with great features, and you'll love the extras we've added standard to all our models.



The wild card in our hand is the HandBook® 486. And now Gateway has rustled up the 50MHz DX2 HandBook. Based on Intel's SL Enhanced energy-efficient processor, it's the fastest subnotebook in the West! The 50MHz DX2 is the new trump card in subnotebooks boasting 8MB of RAM, a whopping 250MB hard drive and MS Office Pro. In addition, you'll draw a full hand of features now standard on all HandBook 486 models.

You get an external diskette drive, a PCMCIA fax/modem, two batteries and a dandy leather carrying case — all included. Once you get your hands on a HandBook, you never want to put it down!

The HandBook 486 is the lightest Intel-based 486 portable available today. It weighs less than three pounds and measures roughly 10 x 6 inches. The HandBook's power and portability make it the perfect

traveling companion.

It has a bright, backlit VGA screen and a comfortable, touch-type keyboard. You'll also like the HandBook's EZ Point™ integrated pointer, PCMCIA Type II slot, and long-lasting nickel metal hydride battery. You can "hot swap" with the HandBook, too — change batteries or

peripherals while the PC is running without rebooting the system or losing any data.

Deal yourself a great hand with the HandBook 486 or the ColorBook from Gateway 2000.



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The Family PC also includes great software. You get five outstanding Microsoft titles, plus the Corel Photo CD which is standard on all Gateway desktop systems:

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Gateway 2000's Family PC includes everything you need for multimedia and communication uses.



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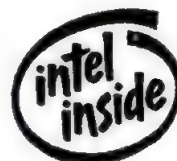
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■ Scanners

New Plustek Scanner Acts As a Fax Machine and Copier

BY DANIEL GROTTA

In theory, Plustek's \$799 ScanFX makes great sense. Why bother having a separate scanner, photocopier, and fax modem when a single device can handle all three tasks?

What makes this hybrid product unique is the way that it takes advantage of your modem and printer—almost as if they were integrated. The small device comes with a dedicated interface board and special 6-foot cable, and it draws its power directly from the computer.

Installing the interface board is simple. The 32K driver automatically configures the ScanFX for your Hayes-compatible modem, though you must select your printer and port manually. You set resolution and mode, preprogram auto-dialing, and input phone numbers from controls on the front panel.

To send a fax, you just insert the page you want to send (the automatic document feeder takes up to ten 8.5- by 14-inch sheets) and hit the FAX button. You can even fax color photographs or illustrations (assuming that the recipient has the capability to receive and print out color) at speeds up to 14,400 bps. While you'll probably want to use your own fax software to receive faxes, Plustek provides basic fax software that works in the background.

To use the ScanFX as a photocopier, you insert up to 10 pages in the document feeder, push the COPY/PRINT button, and copies of the original documents come out of your HP LaserJet/DeskJet, Canon Bubble Jet, or Fargo Primera printer. The ScanFX copies at about 4 pages per minute.

Since the ScanFX is a 24-bit color, Twain-compliant device with an optical resolution of 300

by 600 dots per inch, scanning photos, drawings, or documents happens just as if the ScanFX were a regular scanner, though it's a little slower than other scanners.

The quality of the scans and copies is surprisingly good—comparable to the results you get from scanners costing hundreds more. However, the ScanFX did have trouble accurately interpreting some propor-



ALL-IN-ONE: Plustek's scanner, copier, and fax machine.

tionally spaced typefaces. The only real problem is the lack of an on/off switch or true reset button (the STOP/EJECT button doesn't seem to do anything), which means that you

have to turn off the computer whenever you want to interrupt a scan.

While the ScanFX probably won't satisfy you if you need crisp, high-resolution scans, it's a good choice if you want to add color scanning, copying, and faxing to your desktop without spending an arm and a leg on three separate devices.

► **ScanFX.** List price: \$799. Requires: 4MB RAM, 20MB hard disk space, DOS 5.0 or later, Windows 3.x, fax/modem (printer recommended). Plustek USA Inc., 1362 Bordeaux Dr., Sunnyvale, CA 94089; 800-685-8088, 408-745-7111; fax, 408-745-7562.

Circle 418 on reader service card

■ Windows Utilities

Power Pak: Three Tools to Give Windows a Speed Boost

BY WINN L. ROSCH

One box and one simple installation can speed up your Windows work three ways, without hardware and without hassles. Power Pak for Windows from PC-Kwik doesn't make dramatic changes in your

ager. It spools print jobs, but with a difference: It intercepts them before they get to the printer driver, so you regain control of your system even quicker. You can work on other projects while the driver figures out how to put dots on your paper. To optimize speed, KwikPrint

spools to RAM rather than disk if your system has enough memory.

The second utility, Super PC-Kwik 6.0, is a well-known disk cache that's both faster and safer than Windows' own SmartDrive. It promises safety by defaulting to a mode that doesn't sort or delay write

KwikLoad, which cuts the load time for Windows.

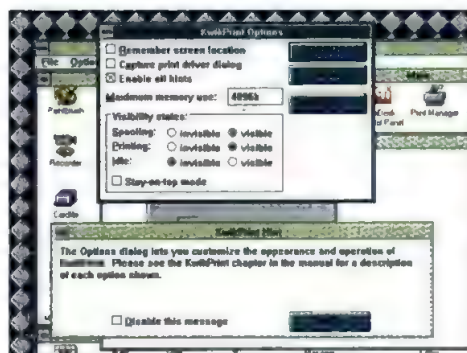
The least satisfying part of the package is KwikScreen. Essentially an improved VGA driver that promises to make 256-color screen updates about as fast as 16-color screen updates, it works only with three major unaccelerated chip sets (Oak, Trident, or Tseng) in VESA modes from 640-by-480 to 1,024-by-768. Considering the ubiquity of graphics acceleration these days KwikScreen has limited appeal, but it can add life to older PCs.

The Power Pak package is linked by a combined automatic setup program that will free most people from the need to tinker with options or configuration files. Die-hard twiddlers can adjust options using the two Windows-based control programs, a print queue manager, and a performance gauge.

Power Pak won't turn a slug into a screamer, but it will help you get the most performance from your current PC.

► **Power Pak for Windows, Version 4.0.** List price: \$99.95 (\$39.95 introductory price for PC-Kwik users). Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. PC-Kwik Corp., 15100 S.W. Koll Parkway, Beaverton, OR 97006; 800-274-5945, 503-644-5644; fax, 503-644-8267.

Circle 419 on reader service card



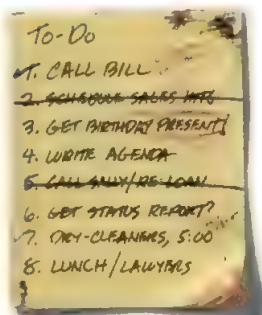
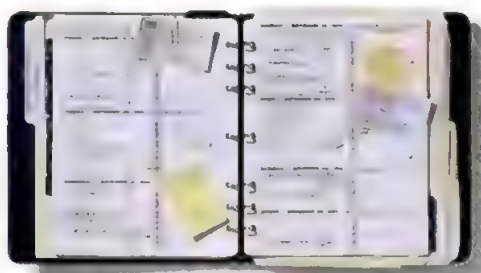
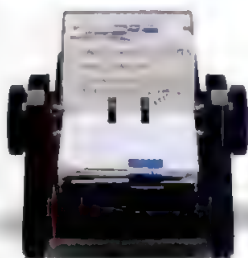
OUTPUT: Power Pak's KwikPrint customizes print commands.

Windows performance, but what it does is effective and, at \$99.95, affordable.

Although the label says Version 4.0, Power Pak is a new product; it combines two new utilities with an update of an old friend.

The most clever is KwikPrint, which replaces Print Man-

requests but nevertheless outpaces SmartDrive by nearly 50 percent. Push PC-Kwik's speed/safety balance to maximum performance, and it's two to three times as fast as SmartDrive. Compared with previous PC-Kwik iterations, this latest version requires less conventional memory (22K) and includes



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CIRCLE 295 ON READER SERVICE CARD

■ Fax Software

Eclipse Fax 6.0 Takes a Minimalist Approach

BY DAVID HASKIN

With Eclipse Fax 6.0, Phoenix Technologies came to a fork in the road and decided not to follow the competition. This upgrade eschews binary file transfer and other advanced communications features found in products such as WinFax PRO in favor of low price (\$84.95) and ease of use.

What makes it easy is Fax Assistant, a tabbed dialog box that lets you set both global and individual options in your fax phonebook. It has tabs for sending, receiving, copying, and saving faxes and for applying optical character recognition (OCR) to faxes. One of the more useful features includes the ability to store faxes to or from specific persons in a specific folder (which Eclipse Fax calls an *index*) automatically. You can also set Fax Assistant to use different cover pages for different fax recipients.

While generally straightforward to use, Fax Assistant can be ponderous. A couple of the tabs are densely packed, and sometimes the product suffers from the use of nonstandard terminology, such as the vague term *index* rather than *folder*.

This new version retains Eclipse Fax's minimalist interface. When you start the program, Eclipse Fax displays a blank screen with no send or receive logs or toolbars visible. Eclipse Fax also continues to use well-designed dialog boxes for its send and receive logs instead of the more graphical folder metaphor used by WinFax PRO. Eclipse Fax adds some worthwhile convenience features, such as the ability to develop second sheets so that all pages of long faxes can contain your logo. It also has most of the other features expected of good fax prod-

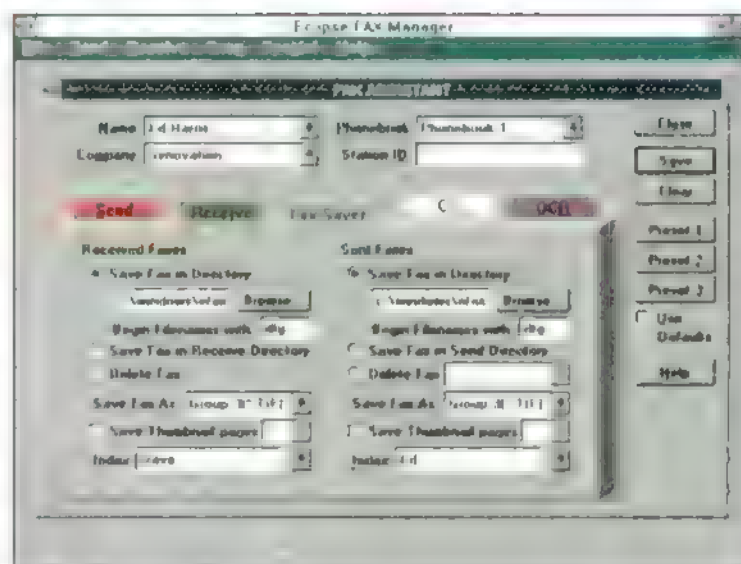
ucts, including OCR, annotation capabilities, and automated credit-card dialing.

Users may wish Eclipse Fax had—in addition to binary file transfer—remote polling, connections to remote fax mailboxes, and the ability to act as an e-mail front end, all of which are included in high-end fax products.

While Eclipse Fax and WinFax PRO formerly were direct competitors, with this release Phoenix Technologies seems hell-bent on making Eclipse Fax

different. Some differences, such as the refusal to use the folder metaphor, are unnecessary and detract from the product. Nevertheless, Eclipse Fax's lower price should make it appealing to home- and small-office users who don't need advanced communications and networking capabilities.

► **Eclipse Fax with Fax Assistant 6.0.** List price: \$84.95. Requires: 4MB hard disk space, Microsoft Windows 3.0 or later. Phoenix



FAX ORGANIZATION: The tabbed dialog box in Fax Assistant aids in setting both global and individual phonebook entries.

Technologies Ltd., 846 University Ave., Norwood, MA 02062-3950; 800-452-0120, 617-551-3725.

Circle 420 on reader service card

■ Optical Character Recognition

Calera Offers a More Integrated WordScan Plus

BY LORI GRUNIN

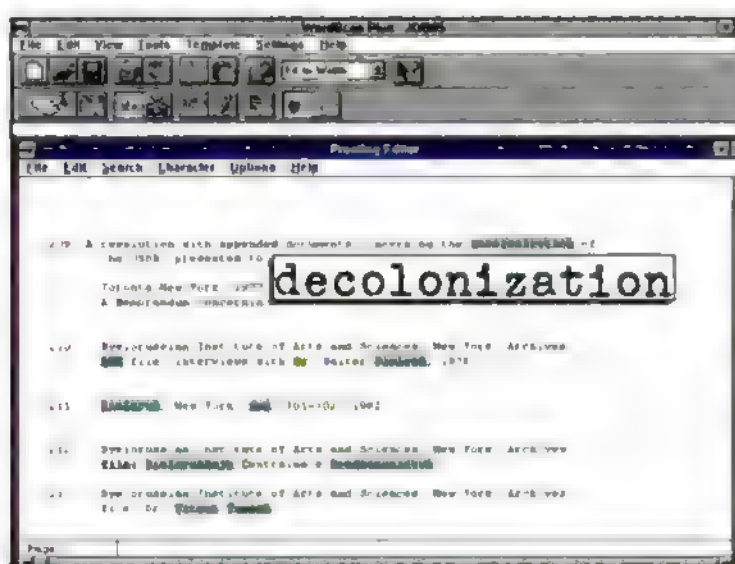
Depending upon your OCR priorities, Version 3.0 of Calera's WordScan Plus (\$595) may leave you satisfied or leave you wanting more. The product's improved integration with other applications and slightly better performance are on target, but not all current users will find compelling reasons to update from the previous version.

The most important new capability is the ability to read text down to 4 points; we found the results from large blocks of 5-point text quite usable. Overall, the program still performs well. It took about 16 seconds per page to process relatively poor-quality text read from a disk file on a 486DX2/66 system with 28MB of RAM (the more memory you have, the better it performs).

The program's core feature set—which includes deferred processing, the ability to handle moderately skewed documents,

a pop-up proofer, and preservation of most important formatting attributes—remains solid. In addition, the program now supports AccuPage 2.0 with Hewlett-Packard scanners, which helps recognition accuracy.

You can also define specific attributes for up to 100 zones by, say, designating a section as



CHAMELEON: WordScan emulates the toolbars found in popular software suites, as with this Microsoft Office-like toolbar.

small dot matrix print. Theoretically, you can mix different text-zone attributes in a template, but every time we tried to create a zone with new attributes, all the zones on the page

changed to reflect those new attributes.

The rest of the changes in the product appear in the interface. The Chameleon Toolbar emulates the toolbars and icons found in Microsoft Office, Borland Office, and Lotus SmartSuite. Calera has also modified its OCR Aware feature, which lets you process and import text directly into your application.

WordScan Plus offers fine OCR capability, and if you need the ability to deskew pages before recognition it's a clearly superior choice to OmniPage Professional. On the other hand, WordScan 3.0, though lacking many features found in WordScan Plus, is priced at a less onerous \$249. Current WordScan Plus users will need to decide for themselves if a fair improvement in accuracy and a new interface is worth the \$149 upgrade price.

► **WordScan Plus 3.0.** List Price: \$595. Requires: 6MB RAM (8MB recommended), Microsoft Windows 3.0 or later. Calera Recognition Systems Inc., 475 Potrero Ave., Sunnyvale, CA 94086-4118; 800-422-5372, 408-720-8300; fax, 408-720-1330.

Circle 421 on reader service card

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CIRCLE 309 ON READER SERVICE CARD



Voice Recognition

Dictate to Your PC With Kurzweil Voice

BY DAVID HASKIN

With the power to turn an office full of keyboard clatter into one full of the chatter of voices, Kurzweil Voice for Windows, Release 1.0 (\$995), is a good first attempt at voice-recognition technology. This first dictation-capable

when you take the needs of Windows into account. Even with sufficient RAM, Voice refuses to load when available Windows resources fall below 50 percent. You also must devote about 30MB of your hard disk to Voice.

Kurzweil's Voice starts out as being speaker-independent,

meaning that you can start using it without training it to recognize your voice. This is both a blessing and a curse: It is faster to set up speaker-independent systems, but they tend to be less accurate. Still, Voice was generally quite accurate out of the box in informal testing. You can train it to respond better to specific

and you can instruct Voice to accept one of those words. If that still doesn't work, you can use another dialog box to spell the word using the Voice alphabet (such as alpha, bravo, charlie as substitutes for the letters a, b, and c). Fortunately, we rarely encountered this situation.

While dictating is simple enough,

Voice's navigation abilities still require you to use the mouse and keyboard. Voice comes with many basic Windows navigation commands as well as commands for 21 specific applications. For example, the product includes 83 commands for Word for Windows. But while Voice's default commands provide access to most menu options, most are inefficient; moving from the bottom to the top of a Word for Windows document requires a separate command for moving up each line.

VOICE EDITOR

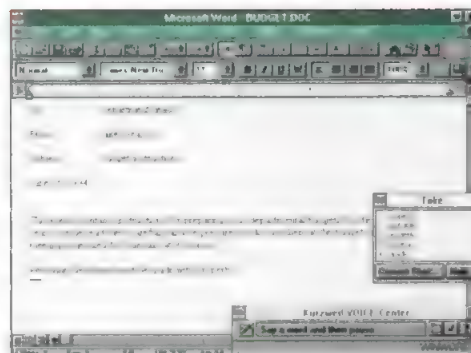
The simple solution is to use the included Command Editor to create Voice-actuated macros. The Command Editor is a simple keystroke macro recorder. After naming the new command and pressing the appropriate keystrokes, you speak the command name three times so Voice recognizes it in the future. Adding new words to the dictionary is accomplished in a similar manner.

Particularly frustrating is the fact that Voice lacks any built-in support for key combinations. While useful, Voice's technology is still merely an augmentation of the keyboard, not a replacement.

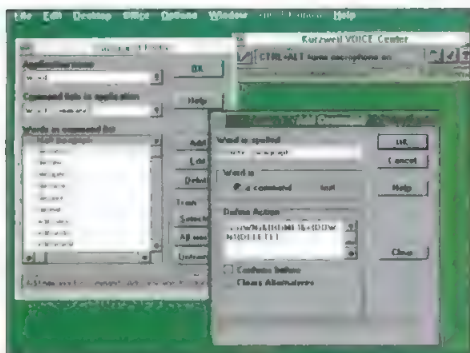
While the product's documentation doesn't provide much

help with common recognition problems, such as the failure to recognize a specific word, Voice's Recognition Wizard is helpful. Like Microsoft Wizards, the Recognition Wizard is an on-screen dialog box that walks beginners through the solutions to a variety of common problems.

Kurzweil's Voice is impressive if you consider it as *start of the art*. But talking to your PC as naturally as if you were aboard the Starship Enterprise is still in the future. Even with its limitations,



WHAT'D I SAY? If Voice doesn't recognize a word you speak, you can instruct it to take one of the sound-alike words displayed in a dialog box.



VOICE EDITOR: The Command Editor allows you to write a Voice-driven macro; repeat the name three times and Voice recognizes it in the future.

ble voice-recognition product for Microsoft Windows is a complete hardware-software package and is generally about as fast and accurate as an average typist.

Besides issuing voice commands for navigating through the Windows environment—an already common voice-recognition practice—Kurzweil's Voice lets you dictate directly into applications. When installing the software, you must select between two vocabularies: one with 20,000 words that requires 8MB of system memory, or the other with 40,000 words that requires 16MB of RAM. In addition, Voice needs an 8-bit ISA slot for its proprietary coprocessing board. The board installed cleanly without conflicts.

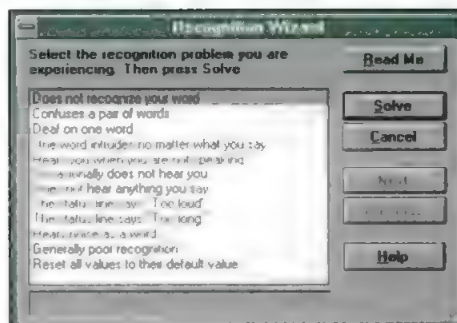
Voice is extremely resource-hungry. For instance, if you use the larger vocabulary, Voice will need 20MB of system memory

words or to your specific voice. This latter training scenario, however, demands at least an 18MB Windows swap file.

Using the included headset/microphone, Voice requires that you pause briefly between words. Although this takes some getting used to, we were dictating accurately at 40 words per minute—the speed of an average typist—fifteen minutes after we first started Voice. Training Voice, combined with practice, increased that rate by several words per minute, and Kurzweil claims that dictation speeds of as high as 60 words per minute are possible.

DOES NOT TRANSLATE

If you say a word that Voice doesn't recognize, you can say "delete that" and say the word again. Kurzweil also displays sound-alike words in a dialog box



CALL FOR HELP: The Recognition Wizard walks beginners through the process of solving common recognition problems.

though, Voice is a solid if sometimes frustrating input solution.

► **Kurzweil Voice for Windows, Release 1.0.** List Price: \$995. Requires: 8MB RAM (16MB recommended), 30MB hard disk space, one 8-bit ISA slot, Microsoft Windows 3.x. Kurzweil Applied Intelligence Inc., 411 Waverley Oaks Rd., Waltham, MA 02154; 800-380-1234; fax, 617-893-6525.

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*Byte Magazine, Jan. 1994. **8am-10pm M-F, 9am-5pm Sat EDT.
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Word Processing Utilities

RoboHelp Uses Word to Build Windows Help Files

BY GREGG KEIZER

Help may be just a menu away, but setting up that help takes either the patience of Job or something like Blue Sky Software Corp.'s \$499 RoboHelp, Version 2.61, an integrated help-file maker that nearly anyone can master.

The perfect tool for constructing sophisticated help files within both Windows and Windows NT, RoboHelp now works with Microsoft Word for Windows 6.0 as well as Word for Windows 2.0. It includes the Windows Help compiler and makes it easy to transform existing documentation into a help system (or visa versa).

RoboHelp posts a floating toolbar on Word's screen and heavily modifies the word

processor's menu structure. As you create and then work in a help project, though, you'll rely on the dozen icons in the toolbar and a blizzard of ensuing dialog boxes.

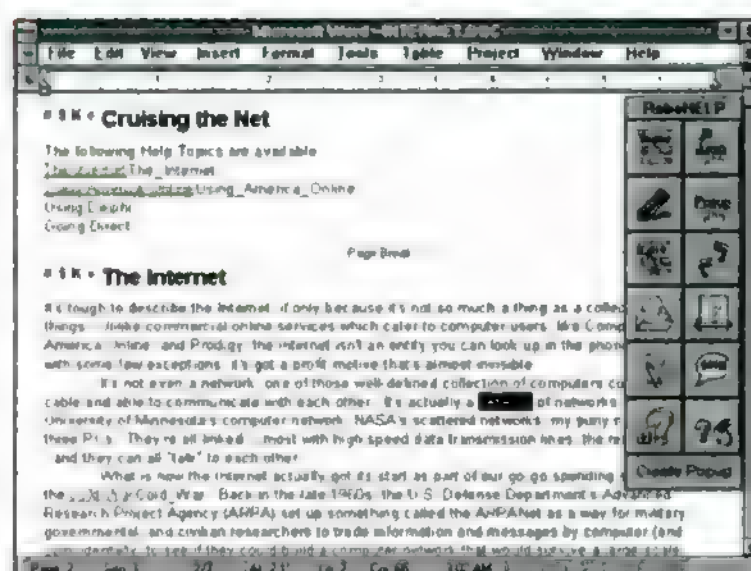
The combination of a familiar writing tool and a point-and-click toolset makes RoboHelp easy to pick up. The tutorial, which oddly enough is on paper rather than on-line, is good enough to ground you on the basics in just a couple of hours. RoboHelp's assistance becomes crucial when you build and link the help file's topics, create pop-ups for brief asides, insert hyper-text hot spots, and add graphics.

To enter a jump (or link) between two topics, for instance, you simply select the appropriate text, click on a button, and pick the second topic. You can

divide a graphic into multiple hot spots in order to link each component to a different pop-up or topic, and you can use the screen-capture utility to grab images.

A Link Logic Tester allows you to simulate a help file's actions before compiling. The actual compiling process takes only a couple of clicks. Compiling a 40K help file with approximately 30 links took less than two minutes on a 66-MHz 486-based system.

RoboHelp 2.61 does not offer tools for generating multimedia-style help files, though Multimedia WinHelp—another Blue Sky title that should be available in the near future—does. But for building professional-quality help files of hyper-text and hot spot graphics,



HELP ME OUT: Although RoboHelp uses Microsoft Word for Windows as its editor, its floating toolbar handles the most common help-file creation chores.

RoboHelp is a slick assistant.

► **RoboHelp, Version 2.61.** List price: \$499 (upgrade, \$229). Requires: 2MB RAM (4MB recommended), 3MB hard disk space, Microsoft Windows 3.1 or later, Microsoft Word for Windows 2.x or 6.x. Blue Sky Software Corp., 7486 La Jolla Blvd., #3, La Jolla, CA 92037; 800-677-4946, 616-459-6365; fax, 619-459-6366.

Circle 423 on reader service card

Data Compression

XingCD Squeezes Data onto CD-ROMs, Slowly

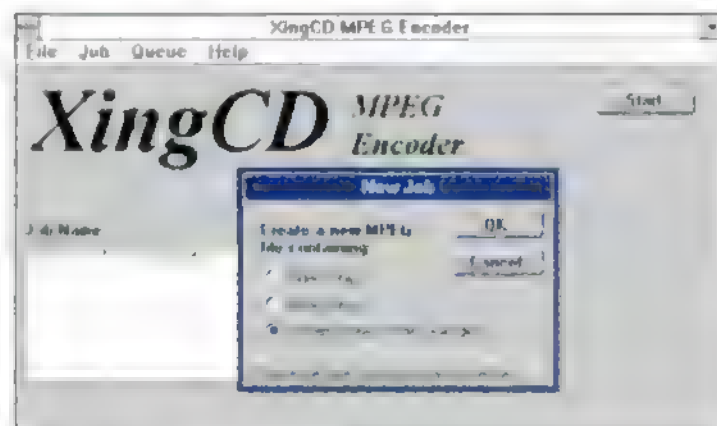
BY MARK BROWNSTEIN

XingCD is a software-based compression program for the multimedia CD-ROM developer who believes that a pocket knife can do the job of a pole pruner. It'll work, but it takes longer and works best when a long stick is added.

Hardware-based MPEG video compression systems cost upwards of \$30,000, while the software-only XingCD costs \$995 and can convert .AVI, Targa, 24-bit .BMP, or MPEG files into compressed MPEG files that can be recorded onto a CD-R. There are three compression modes included: White Book VideoCD specifications, with 30 frames per second and full-screen video; XingCD format, which provides a smaller image on-screen and

takes less time to compress; and XingCD-QSIF format, which produces a quarter-screen compressed image and takes the least time of all to compress.

The beauty of XingCD is its flexibility: You can define new levels of compression, different frame rates, and other parameters. XingCD's designers expect a hardware compression board,



COMPRESS: XingCD lets you choose video-only, audio-only, or full sound and visual compression.

like that provided by Sigma Designs' ReeMagic board, will be used to decompress and view the White Book and XingCD formatted video clips. But XingCD works just fine—albeit slowly—on its own. Its video compression engine works only with 24-bit images. While this lets XingCD work with high-quality original images, you will have to convert 8- or 16-bit .AVI files and .BMP images to 24-bit files.

A list interpreter lets you create an ASCII list of animation frames to be compressed that can be the basis of an animation script. XingCD can process the list to produce an MPEG animation file.

XingCD is no speed demon; compression can take minutes (for small video or audio files) to many hours (for large files). The faster your system is, the faster the com-

pression. Although XingCD is supposed to work in the background, we found that it was most efficient when running as the only active task. Furthermore, it is most comfortable in an uncluttered Windows environment. You'll need Video for Windows 1.1 and should consider adding an MPEG playback board to streamline the process.

You won't get the performance or the output quality of a \$30,000 compression workstation; but at \$995, XingCD is not a bad choice for the occasional compression project.

► **XingCD.** List price: \$995. Requires: 4MB RAM (8MB recommended), 3.1MB hard disk space, Microsoft Windows 3.1 or later, Video for Windows 1.1 Runtime; 24-bit file CODEC required for AVI compression; hardware-based MPEG decompressor recommended. Xing Technology Corp., 1540 W. Branch St., Arroyo Grande, CA 93420; 805-473-0145.

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STATISTICA/w

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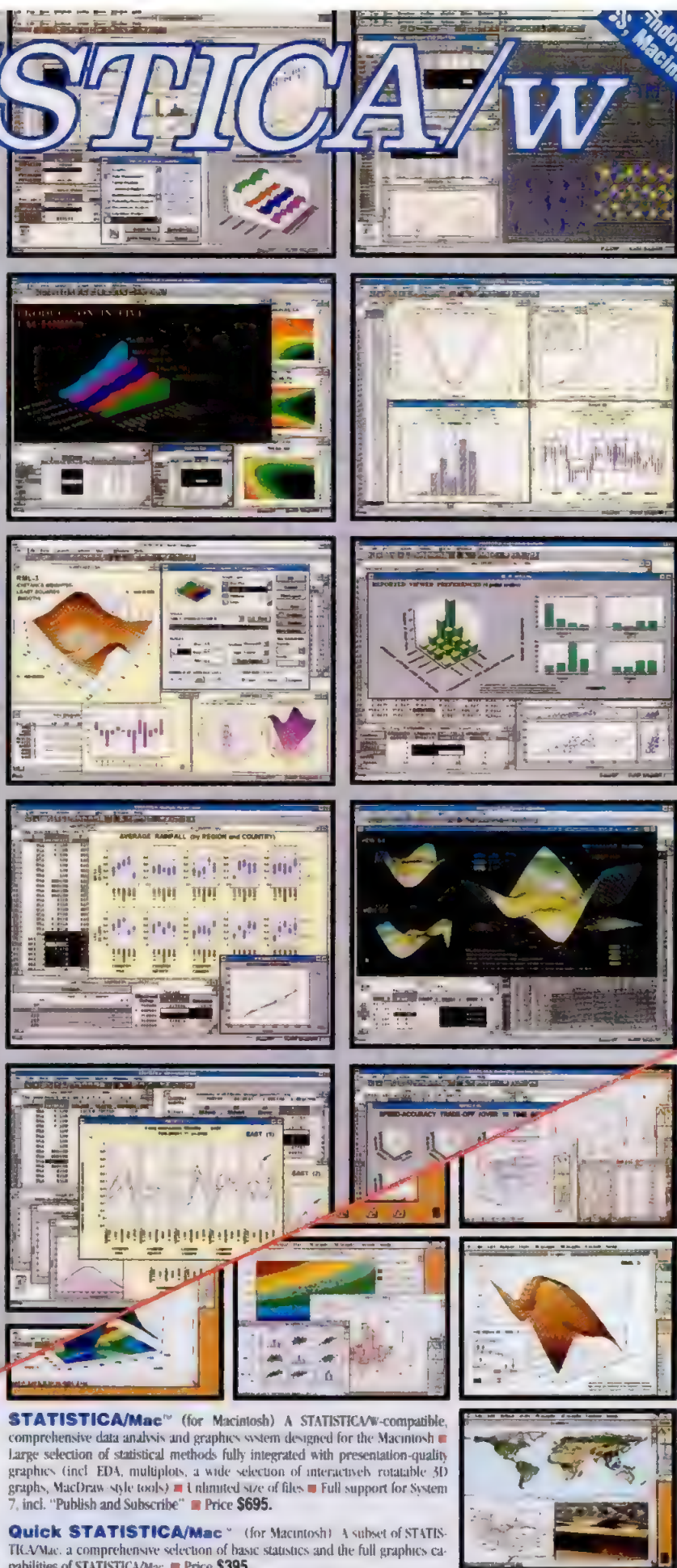


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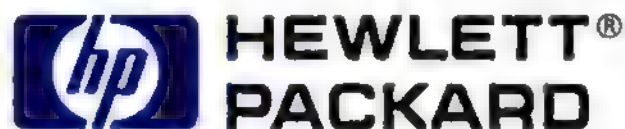
And with good reason. Our broad range of PCs not only meets users' expectations for power and ease of use, it also answers the needs of a network manager. With built-in features like on-board networking, advanced security and asset tracking, HP PCs have what it takes to be top performers on virtually any network. And soon our expertise in network management will reach all the way to the desktop, as we continue to pioneer the development of DMI (Desktop Management Interface).

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If you're connecting PCs to a network,
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Advanced Bus Architecture	VL-bus		
Integrated Networking Interface	16-bit		
Integrated, multiprotocol Boot-ROM	X		
ISA Plug-n-Play Compliant	X	X	
Multilevel Security Features	X	X	X
Asset tracking	X	X	
PC tattooing	X	X	
Optional Desktop Management Software	X		
Bi-directional parallel port	X	X	X
Desktop Management Interface (DMI) ²	X		



**HP quality in
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- Intel 486SX, 486DX2 and DX4
- Chip upgrades to higher performance
- On-board accelerated local-bus video
- 210-MB hard drive¹
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- 512-KB or 1-MB of Video RAM standard
- ISA Plug-n-Play compliant
- Desktop Power Management
- EPA Energy Star certified

**High-performance
network-ready PCs
in a slimline package.**

- Intel 25- and 33-MHz 486SX, 50- and 66-MHz 486DX2, upgradable to Pentium Overdrive
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- 170-MB, 14-ms Fast-IDE hard drive
- 32-bit Fast-IDE local-bus hard disk interface
- 4- or 8-MB RAM, expandable to 96-MB
- Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution

**High-performance
PCs for the
connected office**

- Intel 33-MHz 486SX; 50- and 66-MHz 486DX2, 100-MHz DX4, upgradable to Pentium Overdrive
- Optional 128- or 256-KB second level cache
- Four mass storage shelves; four expansion slots
- One available 32-bit VL-bus slot
- 210-MB, 14-ms Fast-IDE hard drive
- 32-bit Fast-IDE local-bus hard disk interface
- 8-MB RAM, expandable to 96-MB

**Top performance for
experts in connected
environments.**

- Intel 60-MHz Pentium with 256-KB write-back cache
- One PCI slot, one shared PCI/ISA slot, two ISA slots
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- 270-MB Fast-IDE hard drive with 12-ms access time¹
- Integrated S3 928PCI graphics accelerator
- 2 MB of VRAM expandable to 4 MB, 1600 x 1200 video resolution
- 8-MB RAM, expandable to 192-MB



HP Vectra VL2



HP Vectra N2



HP Vectra M2



HP Vectra XP

- Local bus Fast-IDE hard disk interface*
- 1280 x 1024 video resolution*
- Optional 128- or 256-KB cache memory*
- Free three-year limited warranty for parts and labor²

- 1 MB of video RAM standard, expandable to 2 MB
- Slimline package with two mass storage shelves and three ISA slots
- Optional integrated 10Base-T networking
- Multilevel security
- EPA Energy Star certified
- ISA Autoconfiguration utility (Plug-n-Play)
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²

- Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution
- Optional integrated 10Base-T networking
- Systems Diagnostics Utility
- EPA Energy Star certified
- ISA Autoconfiguration utility (Plug-n-Play)
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²

- Integrated 16-bit 10Base-T networking interface with bus-master DMA
- Flash EPROM
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- Asset tracking with non-erasable serial number and customizable PC tattooing
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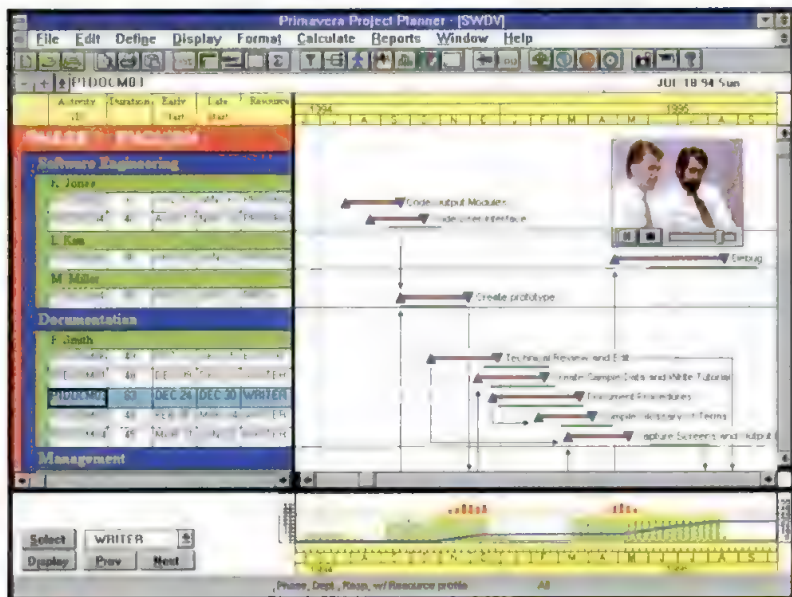
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All HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed, HP mouse and keyboard included. *Feature included with some models. †List price, dealer prices may vary. Monitor not included. ‡Other capacities available. †First year on-site, 24-hour service. Second and third year return to dealer. ‡Available 9/1/94. †With permission CRN/Benchmark. MS-DOS is a U.S. registered trademark and Windows is a trademark of Microsoft Corporation. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. PPG403 ©1994 Hewlett-Packard Company

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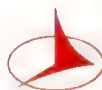
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NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Adam A. Hicks

NEW

PC*MAX Gives Laptops a Voice



Sound off with the pocket-size PC*MAX 2002 sound box.

To show off your multimedia presentations or to add background music to a speech, **Giltro-Electronics & Assoc.**'s

PC*MAX gives you full stereo sound in a 12-ounce, pocket-size 3.5- by 1.5- by 6.5-inch box to carry on the road. The unit connects to a parallel port on your PC, but you can still attach your printer by means

of a pass-through parallel port. Each PC*MAX model contains a microphone and two speakers, as well as jacks for an optional external mike and speakers. Each model is capable of up to 5 volts of audio output and has an input-level sensitivity of 3 mV, along with a dynamic range of 72 dB. You can run each unit on a battery or via a wall plug.

► **PC*MAX 2002.** List price: \$229. **PC*MAX 2003.** List price: \$259. **Giltro-Electronics & Assoc.,** 5391 Kenilworth Dr., Huntington Beach, CA 92649-4526; 800-445-8769, 714-840-6780; fax, 714-840-5711.

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NEW

Digitize Family Health Records

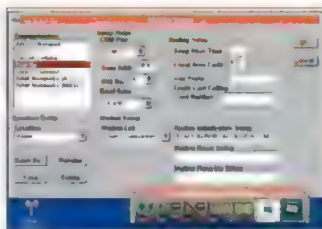
Great Bear Technology has created a program that will help you fine-tune your latest personal health goals, log long-term health data, and organize your personal medical records. **Family HealthTracker** has a section for tracking your daily exercise patterns, fat intake, body measurements, and vital signs. A graphing feature can show you relationships among up to five variables—such as your workout patterns, your body weight, and your cholesterol levels—so you can track improvements or spot trends. The package also gives you a central location where you can track the medical history of family members, as well as the associated costs and insurance information.

► **Family HealthTracker.** List price: \$49. **Great Bear Technology Inc.,** 1100 Moraga Way, Moraga, CA 94556; 800-795-4325, 510-631-1600; fax, 510-631-6735.

Circle 404 on reader service card.

Photography by Thom O'Connor

HOT PROSPECT



AirAccess 2.0 Covers All Notebook Links to the LAN

Workers who travel or who work at home have a number of ways to connect to an office LAN. Now those connections can be made easier and more flexible with **AirSoft's AirAccess, Version 2.0.** Version 1.0, which shipped at the beginning of the year, was designed for wireless connections; the new version works on standard phone lines as well. This application-independent software replicates a LAN on your remote PC; regardless of the type of connection (and even if the connection is broken), you can run local applications, update remote files, and continue to work as if you were connected to the LAN.

AirAccess removes the need for separate remote e-mail, file-transfer, remote-control, and remote-node packages; this one program includes algorithms intended to extend all the functions of a LAN to mobile users painlessly. The host software loads on a desktop PC, on **NetWare, VINES,** or **LAN Manager** servers, or on **LANtastic** networks, making it suitable for individual or multiuser access.

By transferring only the data that's been changed—and using a compressed format—the package reduces the amount and size of data sent.

► **AirAccess, Version 2.0.** List price: \$199; 2-user pack, \$499; 4-user pack, \$699; 8-user pack, \$899. **AirSoft Inc.,** 1900 Embarcadero Rd., #204, Palo Alto, CA 94303; 800-708-4247, 415-354-8120; fax, 415-424-9506.

Circle 402 on reader service card.

NEW

Portable CD-ROM Drive: Double Speed, 1 Pound, and Only \$400

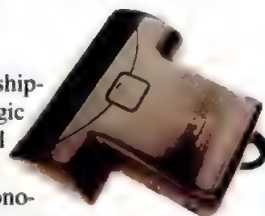
You may not need to bring a CD-ROM drive on every business trip you take, but for the times when playing a CD on the road is mission-critical, the **CD Porta-Drive T4100** from **CD Technology** is a good solution. This 1- by 6- by 8-inch drive has a **Toshiba XM-4101** drive mechanism with an average access time of 320 milliseconds and a transfer rate of 300 kilobits per second. You'll also find a 64K memory buffer, a SCSI-2 or SCSI interface, and a headphone jack. The T4100 is compatible with **MPC** computer systems, **Macintoshes,** and **Photo CD** applications and will even play your standard audio CDs. Best of all, it's a caddyless system that can be positioned either horizontally or vertically without having playback problems. As an added bonus for travelers, **CD Technology** has included a bundle of **MediAlive's America Alive** CD-ROM interactive tour of the United States, a \$49 value.

► **CD Porta-Drive T4100.** List price: \$400. **CD Technology Inc.,** 764 San Aleso Ave., Sunnyvale, CA 94086; 408-752-8500; fax, 408-752-8501.

Circle 405 on reader service card.

NEW

Capture Color in the Palm Of Your Hand



Mustek has begun shipping the **ScanMagic Color II**, a hand-held scanner that gives you color scanning at a monochrome scanner price. The \$300 unit fits in the palm of your hand, which helps to minimize shaking during scans, and it will do both 24-bit (16.7 million) colors and

high-quality 256 gray-scale captures at 100- to 400-dot-per-inch resolution. The **ScanMagic Color II** is **Twain-compatible** and is bundled with **Micrografx's PhotoMagic LE**, a high-powered image-manipulation package, and **Ocron's Perceive Personal** software, an optical charac-

The **ScanMagic Color II** unit fits into the palm of your hand.

ter recognition package that recognizes multiple fonts and text sizes.

► **Mustek ScanMagic Color II.** List price: \$299. Mustek Inc., 15225 Alton Pkwy., Irvine, CA 92718; 800-468-7835, 714-453-0110; fax, 714-453-1010.

Circle 406 on reader service card.

NEW

Epson Outputs Its First Color Ink Jet Printers

Color printing is making its way to a desktop near you as printer manufacturers begin to focus on the growing home market for ink jet printers. **Epson America's** first color ink jet printer, the Stylus Color, implements proprietary piezoelectric printing technology that delivers 360- by 360-dot-per-inch (dpi) resolution on plain paper and the option to use specially coated paper from Epson for up to 720- by 720-dpi output. The printer ships with four scalable fonts and five bitmapped fonts, and has separate cartridges for printing cyan, yellow, magenta, and black ink at either 200 characters per second in monochrome or 3 minutes per page in color. The Epson ink jet technology uses high-pressure nozzles that are activated by electronic impulses (not by heat, as thermal printers are) to give you colors that won't bleed. The Epson Stylus color driver limits the time you'll spend waiting for image processing, because it performs tasks in the background and frees applications as soon as possible.

► **Epson Stylus Color.** List price: \$699. Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-289-3776, 310-782-0770; fax, 310-782-5220.

Circle 407 on reader service card.

IMPROVED

Gupta Makes Its Development Tool Easier to Use and More Powerful

At the end of the month, **Gupta Corp.** will begin shipping a new release of SQLWindows. Version 5.0 will open doors for beginning programmers by making powerful database languages easier to use and providing enhanced workgroup and 4GL (fourth-generation language) compilers to work across an enterprise network.

Prepackaged "QuickObjects" eliminate the need to write code. Instead, you use the QuickObjects to link data, create presentations of data that are automatically updated, and create commands that execute applications based on data analysis. The objects can be customized

BRIEFS

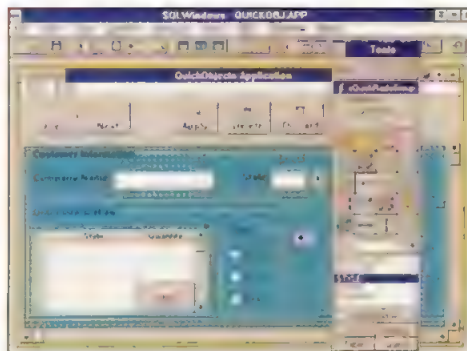
Software

Alpha Software Corp. continues to develop its DOS relational database for nondatabase experts. Alpha Four is now in Version 4.0 (\$495). The new package has added a number of features that users demanded, yet still maintains its ease of use and speed. The latest version adds better memory management, new search capabilities, supports attached image files, and has an integrated backup and restore utility for peace of mind. 800-852-5750, ext. 117, 617-229-2924.

Coactive Computing Corp. wants to take over every small LAN in the country with the Coactive Connector, a proprietary software/hardware solution for printer sharing and file transfer. Version 2.0 (\$149.95 each or a two-PC starter kit for \$229.95) still connects to the parallel port via standard telephone wires but now includes CoMail, a Coactive e-mail system that will allow you to send messages and attach files to messages over the Coactive network. 415-802-1080

Avanti Systems has a software-based solution to help reduce the stress of keyboard entry. ASER ergonomic software (\$99) changes the keyboard layout on any Windows- or DOS-based PC so that the most frequently used keys are all located on the home row. Thus, the total number of strokes you'll take will be less, and there will be less chance of suffering from Repetitive Strain Injury. The package includes an on-line tutorial that helps orient you to the new layout, which is designed to balance stress between the hands. 708-575-0022.

Computer Vectors recently released Bear Bone\$, Version 2.5, a communications package that lets you transfer text or binary files between PC and mainframe systems using IBM's INDSFILE. Bear Bone\$ works with any Windows or DOS asynchronous communications software to simplify mainframe file transfers. The latest release adds support for additional terminal emulations, including ANSI and Procomm 3270/950, and includes additional protocol converters. 808-329-6645



QuickObjects: Gupta's SQLWindows, Version 5.0, packages code into easily programmed modules.

either by developing your own code or by using that of independent software vendors, which will be on the market shortly. With the new objects, you'll be able to fully integrate with e-mail packages and Lotus Notes, putting your workgroup in touch with as much corporate data as possible. The new version can also convert 4GL code into C code, which will boost performance and make the applications you develop even more powerful.

► **SQLWindows, Version 5.0.** List price: *Corporate Edition*, \$3,395; *Network Edition*, \$1,995. Gupta Corp., 1060 Marsh Rd., Menlo Park, CA 94025; 415-321-9500; fax, 415-321-5471.

Circle 408 on reader service card.

NEW

QMS Ships Workgroup Printers That Don't Skimp on Features

QMS has updated its year-old workgroup printer line, the Hammerhead Print Systems, with two new models: the 10-page-per-minute (ppm) QMS 1060 and the 16-ppm QMS 1660 Print Systems. The units are based on 20-MHz and 33-MHz IDT RISC internal controllers, respectively. These workgroup workhorses can support simultaneous inputs from multiple users, even if they're using different network protocols. The units also support many language emulations, including PostScript levels 1 and 2 (with 39 typefaces and True Type font scaling) and line printer fonts.

The printers have simultaneous multitasking and resident spooling to RAM. In addition, the transparent context switching will change fonts and emulations based on the requirements of each print job. The 1060 comes standard with 8MB of RAM (upgradable up to 64MB) and will support 600- by 600-dot-per-inch resolution on paper as large as legal size. The more powerful 1660 has a standard 12MB of RAM (upgradable to 64MB) and can handle

dBASE users discover FoxPro 2.6 falls short

“FoxPro 2.6 fell well short of the claim in [Microsoft] ads that ‘the unique AutoMigrate feature lets you move your existing dBASE files effortlessly into FoxPro.’”

“FoxPro for Windows crashed several times when generating a project involving dBASE code.”

“Microsoft officials reported that the problem was that FoxPro is unable to handle certain dBASE statements.”

“When we attempted to migrate our art gallery management system to FoxPro, the whole process was frustrating.”

“Besides these compatibility shortcomings, there are also design flaws that make 2.6 unsuitable for a tentative user.”

“This reviewer, a dBASE user and programmer, tried unsuccessfully to “AutoMigrate” the target application rather than performing the relatively laborious task of learning a complex new software platform. In the end, however, that is what FoxPro 2.6 required.”

PC WEEK review exposes compatibility flaws

May 16, 1994

The closer dBASE® for Windows gets to shipping, the more Microsoft seems compelled to cover FoxPro compatibility flaws with untrue marketing claims. Perhaps they've seen how easy dBASE for Windows makes it for all developers to create great Windows database applications using their existing knowledge of dBASE. Perhaps they've seen how naturally applications created with dBASE for Windows can be upsized to client/server applications. Perhaps they've seen how its new “Plug-and-Play” Architecture makes dBASE for Windows totally open to work with your favorite tools and important local and SQL data.

Whatever the case, reacting by claiming that FoxPro addresses dBASE customer's needs is irresponsible. But don't take our word for it. Read the May 16th *PC WEEK* review for yourself.

Build your database strategy on superior technology, not marketing hype

Visual design tools, full use of Windows, reusable object-oriented code, and seamless compatibility are what you've asked for. And that's exactly what you get in dBASE for Windows. dBASE will set the standard for data management and database application development for a long time to come. We know because our customers who have tested beta versions of dBASE for Windows are telling us, “thanks for taking the time to make it right.” Borland has been the leader in the database market for many years. And if there's one thing we understand, it's that when it comes to your data, it has to work right the first time. dBASE for Windows is your best path from DOS to Windows and client/server.

Reserve your copy today. Be the first to get dBASE for Windows. Call now!

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No Matter How Attractive
They Mean Nothing



The Individual Features, If You Can't Connect.

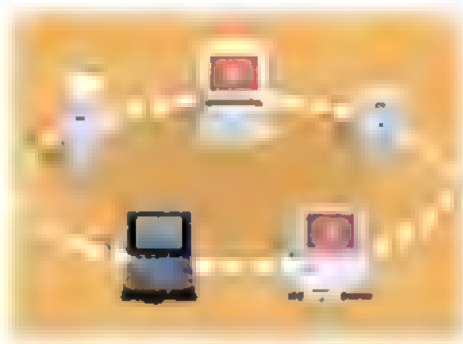
Connecting. It's really what the world is all about. The need to make contact, to work in concert, to be connected, is becoming more critical every day. At Zenith Data Systems, we not only recognize that fact, we're proud to be playing a major part in making it a reality.

As the world continues to shrink, so do corporate computing resources: moving from "glass rooms" to office floors, to desktops, to laptops, to briefcases—and soon to pockets and purses. And a whole new breed of highly skilled and highly mobile workers is coming on-line to use them.

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that addresses the numerous concerns of the individual, but also provides solutions for workgroups and enterprises. We're pioneering a new class of computing products



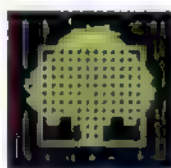
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designed to answer the needs of the business environment. Every ZDS product shares a common birthright: they're built to help people work together better. To get their jobs done faster. To get and stay connected.

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a maximum resolution of 1,200 by 600 dpi full bleed on pages up to ledger size (11 by 17 inches). There are also several upgrade options, including an internal hard disk, Kanji language support, and extra-large paper bins.

► **QMS 1060 Print System.** List price: \$2,699.
QMS 1660 Print System. List price: \$4,199.
QMS Inc., One Magnum Pass, Mobile, AL 36689; 800-523-2696, 205-633-4300; fax, 205-633-0013.

Circle 409 on reader service card.

IMPROVED

Nomadic Systems Updates SmartSync with SmartDelta

Last October, **Nomadic Systems** released Version 1.0 of SmartSync, a remote file-transfer program. Now SmartSync, Version 2.0, reduces file-transfer time and works with both wired and wireless data transfers. To minimize connect times, Version 2.0 lets you filter the types of files you want synchronized by extension type, transfers only that portion of the file where data has been changed, and then compresses the data at ratios of up to four to one.

The software lets you specify security on directories and define file synchronization as bi- or unidirectional, and it notifies you about potential file conflicts before files are overwritten. SmartSync has a Windows interface and works with networks running NetWare 3.11 or higher. SmartSync lets you create a phone book of different connections over serial, infrared, packet-radio, or cellular modems, each with different associated file-transfer specifications.

► **SmartSync, Version 2.0.** List price: *single-user version, \$169.95; upgrade, \$19.95. Five-user packs, \$495.* Nomadic Systems Inc., 300 Ferguson Dr., #200, Mountain View, CA 94043; 800-432-1293, 415-335-4310; fax, 415-968-8300.

Circle 410 on reader service card.

NEW

Lotus Notes Speaks Its Own Visual Programming Language

Software that puts information from multiple applications and databases at the fingertips of end users is invaluable. **Lotus Development Corp.** takes its Lotus Notes groupware application into yet another corporate arena by releasing Lotus Notes ViP (Visual Programmer), which allows developers to build such custom applications based on the Notes environment.

Lotus Notes ViP is based on LotusScript (a Lotus developed programming language that is

BRIEFS

Software

Patton & Patton Software Corp. anticipates success with its new Windows flowcharting package. Flow Charting 4 for Windows (\$315 for the single-user version, \$1,250 for a five-user pack) is the official name to indicate that it comes after several DOS versions, but it is in fact the first Windows release. You can design objects of multiple shapes and sizes, save them for later use, and change them on the fly. 800-525-0082, 408-778-6557.

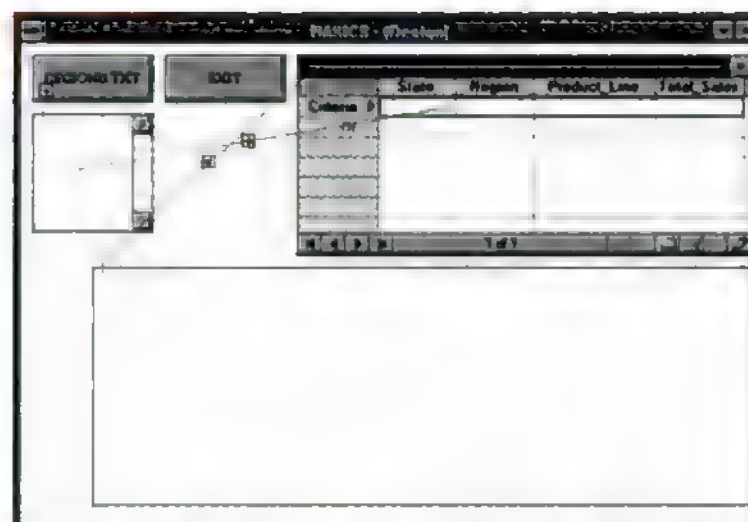
Expert Brand Software has a database package for tracking your family's genealogy in a central location. Expert Personal Roots for Windows (\$14.95) includes the database program and data collection forms you'll need to initiate and track a search of your family roots. Once you've entered your family data, you can preview and print reports. The family tree data can be viewed and printed into mailing lists, ancestor profiles, and a chart format that fits 30 generations on a single page. 800-759-2562, 305-567-9990.

Hardware

ASC Systems has a solution for crowded work areas. PC/Display-Stations, which feature flat-panel LCD screens, are available in a variety of models with prices that range from \$700 for a 9.5-inch monochrome display to \$4,900 for a 14-inch active-matrix color model. The units can stand on legs for portable use or you can use the articulating arm mount to levitate and rotate the displays as needed. 313-882-1133

The Bilbo Keyboard Control Pedals (\$69.95 limited-time introductory price for a set of three pedals) from **Bilbo Innovations** gives you yet another alternative to keyboard data entry. These pedals can be programmed to take the place of selected keystrokes that are frequently used. You can then control keys with your feet, which are less susceptible to Repetitive Strain Injury than your hands. 800-203-0092, 608-233-6121.

Dolch Computer Systems, the makers of ruggedized systems for industrial work environments, also have color



Lotus Notes ViP: Making relationships between data is as easy as drawing lines.

syntactically compatible with ANSI-standard BASIC) and includes a script editor and debugger as part of the package. You will be able to do Rapid Application Development via visual linking by either drawing links between objects or using predefined link behaviors provided by Lotus. One of the benefits of developing an application based on Notes is that you will be able to take better advantage of the workgroup functions in Notes, such as mail upon save, replication, and distribution, while accessing corporate information from all Notes, PC-based, and relational database sources.

► **Lotus Notes ViP.** List price: \$995. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-346-1305, 617-577-8500; fax, 617-693-0968.

Circle 411 on reader service card.

IMPROVED

Faster Remote Control with Symantec's pcAnywhere

If all you need is to access your desktop PC occasionally or administer a LAN from a remote location, the remote-access packages mentioned thus far in this section may not be the right choice. You may need only a remote-control package, in which case **Symantec Corp.**'s The Norton pcAnywhere, Version 5.0 for DOS, should do the trick. It's the latest update of Symantec's best selling remote-control software.

Speed is critical in remote control and Symantec's new version will cut your transfer times by 20 percent because it provides better compression techniques. Also, your system should run better when you use the new host TSR, which frees more conventional memory on the host PC. From a management perspective, Version 5.0 saves you time with bidirectional gateways that eliminate the need to maintain incoming and outgoing access points. The new release also gives you access to remote

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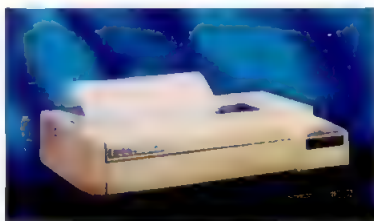


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New & Improved

files using host-based applications, and it adds new security features such as restricted drive access and data encryption.

► **The Norton pcAnywhere, Version 5.0 for DOS.** List price: **\$179.** Upgrade for registered users of Version 4.5, \$49.95. Symantec Corp., 2500 Broadway, #200, Santa Monica, CA 90404; 800-441-7234, 310-453-4600; fax, 310-453-0636. Circle 412 on reader service card.

NEW

Three-in-One Wireless Communicator

For those of you who never feel quite accessible enough, the AirCommunicator, from **Air Communications**, is a wireless gadget that you'll definitely want to check out. The only wireless device this high-speed cellular fax, data, and voice unit doesn't replace is your pager. The unit weighs only 16 ounces,



This portable wireless unit from Air Communications makes you more accessible.

connects to your portable using the serial port, transmits data at rates of up to 57,600 bps, and supports connections up to 14,400 bps. You can also create a communication link to other modems using standard RJ-11 phone jacks, or you can unplug the unit and use it as a full-featured cellular phone.

In addition to using its own software to monitor transmission signals and system power, Air Communications bundles both MicroPhone LT from Software Ventures and WinFax Lite from Delrina.

► **AirCommunicator.** List price: **\$1,595.** Air Communications Inc., 274 San Geronimo Way, Sunnyvale, CA 94086; 800-247-3282, 408-749-9883; 408-749-8089.

Circle 413 on reader service card.

NEW

PrintMaster Will Talk You into the Basics of Desktop Publishing

Multimedia help systems are on the way in many software packages, including **MicroLogic Software's** new PrintMaster Gold CD Bonus Pack. This desktop publishing package was originally disk-based, but now takes advantage of the CD-ROM's storage capacity to provide you with a talking tutor and hundreds of fonts and templates and a thousand clip-art images, all of which are tar-

BRIEFS

Hardware

flat-panel display systems. A 14-inch active-matrix TrueColor model costs \$6,900. Alternatively, you can get smaller models with either monochrome or color displays. To fit the monitor into any environment, you can choose options such as a swivel base or wall mount, sunlight readable screens, and touch screens. Dolch also sells IntelliView industrial computing systems, which house a complete computer system in the size of the flat-panel screen starting at \$8,900. 800-538-7506, 408-957-6575.

And Finally...

NEC Technologies has reduced the prices of the MultiSpin 3X family of CD-ROM readers by 17 percent, which will save you about \$100 on the \$600 MultiSpin 3Xe, just under \$50 on the \$500 MultiSpin 3Xi, and about \$40 on the \$455 MultiSpin 3Xp. . . **Central**

Point Software takes a shot at the multifunction utility market by selling its SpeedTools 2.0 for Windows and Emergency Disk 2.0 for Windows for \$29.95. . . **HarperReference**, a division of HarperCollins Publishers,

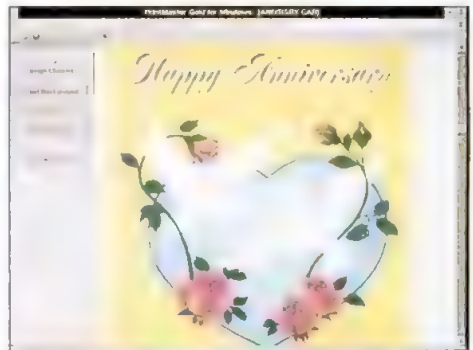
announced it will produce consumer software and CD-ROM products based on and packaged with books it publishes. The first title is The American Sign Language Dictionary by Martin Sternberg. . . **Compton's NewMedia**

and Intel Corp. are developing new delivery systems to put Compton's Interactive Encyclopedia and The Sporting News Pro Football Guide into homes via cable networks. . . **Great Bear Technology** has dropped prices on its currently shipping Windows multimedia reference-based software products from \$69 and \$59 to \$49. . .

Zenith Data Systems dropped prices on its Z-Station desktop systems by as much as 18 percent: a savings of \$320 on the 50-MHz 486DX/2 system. It is now priced at \$1,779. . . **Pinnacle**

Micro goes after market share in a big way by cutting CD-R prices by \$1,500, making the RCD-202 PC for Windows drop to \$2,695. . . **Interleaf** will integrate Berger-Levrault's Standard General Markup Language technology as part of an enterprise-wide document management strategy.

getted for the first time user. The productivity program talks you through the process of creating greeting cards, banners, calendars, signs, and stationary. Following the lead of many other entry-level packages, PrintMaster has some sophisticated capabilities and features,



MicroLogic's talking tutor gives you interactive desktop publishing instruction.

such as support for TrueType fonts that scale up to 9 feet tall, support for 24-bit color output, and the ability to print a variety of graphics files—including .BMP, .PCX, and TIFF—all up to 6 feet tall.

► **PrintMaster Gold CD Bonus Pack.** List price: **\$79.95.** MicroLogic Software Inc., 1351 Ocean Ave., Emeryville, CA 94608-1128; 800-888-9078, 510-652-5464; fax, 510-652-5040.

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NEW

TEAC Does Double-Speed Drives Twice as Fast

TEAC America has announced that it will begin shipping quadruple-speed CD-ROM drives later this summer for surprisingly low prices.

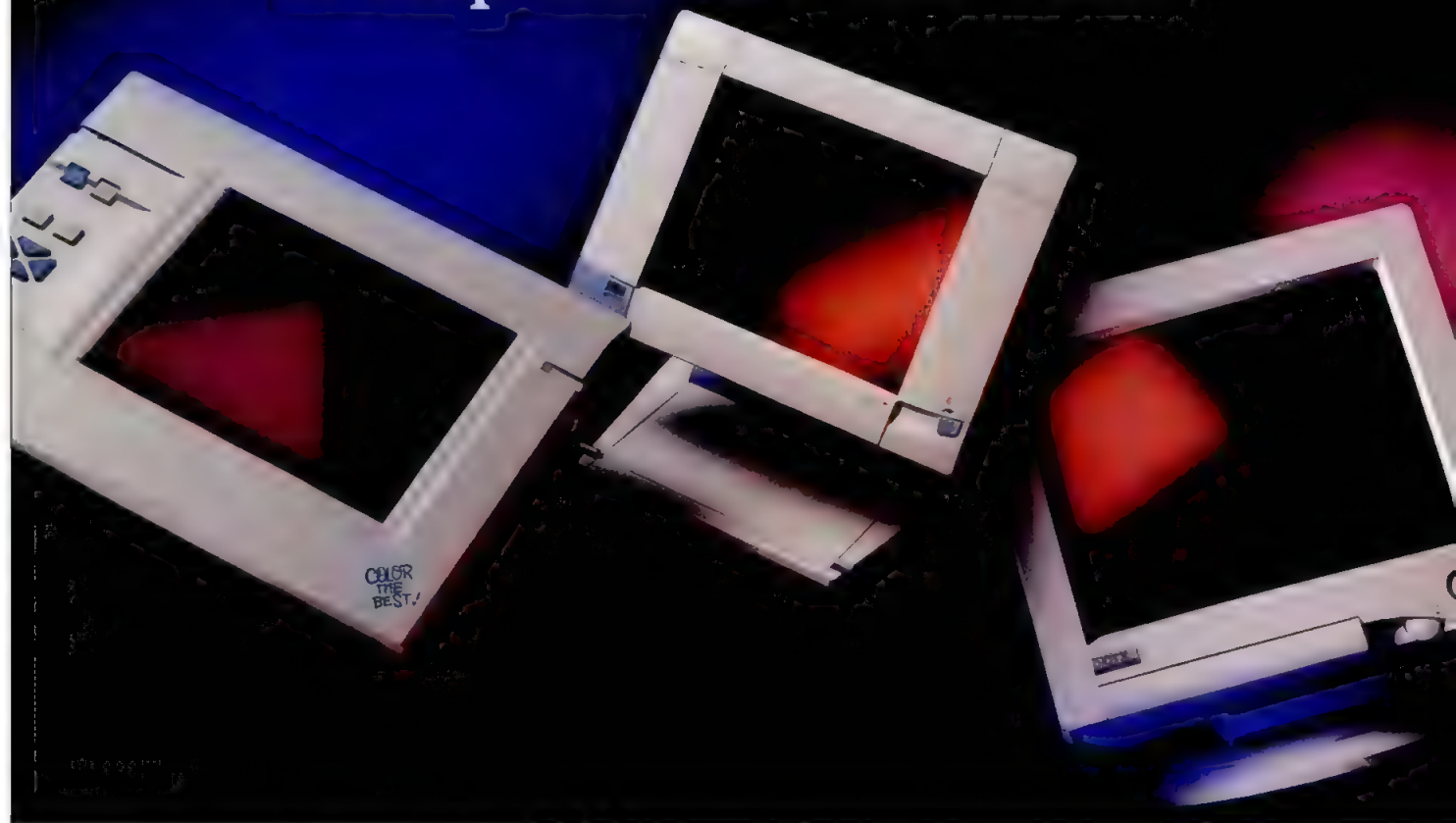
The TEAC Super Quad AT will have a data-transfer rate of 600 kilobits per second and an access time of 195 milliseconds in a standard 5.25- by 1-inch form factor, all for only \$499. The drive will support CD-ROM XA, have multisession Photo CD capability, and be MPC Level compliant.

With its increased speeds and full compatibility with the Creative Labs Sound Blaster, the Super Quad AT will make your multimedia CD-ROM applications move. The new drive will also feature a motorized disk tray, a front-mounted headphone jack, and an outgoing rear panel line for audio connections.

► **TEAC SuperQuad AT.** List price: **\$499.** TEAC America Inc., 7733 Telegraph Rd., Montebello, CA 90640; 213-726-0303; fax, 213-727-7672.

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Take our new high-resolution, flicker-free, 17-inch Super VGA "green" monitors. A low 0.26mm dot pitch makes images crystal clear. And viewing is easier on your eyes and body thanks to a special flat, square, anti-glare, anti-reflection, anti-static screen; low MPR II radiation standards and handsome ergonomic design.

Their larger size and controllability make them ideal for complex Windows™, Mac® and SPARC® applications.

They're easy on your pocketbook too. And not just because of their low initial price and two-year warranty. When "on" but inactive, power consumption goes down from 130 watts to less than 5 watts. Imagine the cost savings if you had ten monitors. Or a thousand.

CTX GREEN MONITOR FEATURE SUMMARY							
MODEL	6466GM	1451GM	1462GM	1562GM	1566GM	1766GM	1786GM
Size	14"	14"	14"	15"	15"	17"	17"
Dot Pitch (mm)	0.26	0.26	0.26	0.26	0.26	0.27	0.26
Hor. Freq. (KHz)	30-38	30-50	30-62	30-62	30-65	30-65	30-85
1800 x 1280 NI	—	—	—	—	—	—	Yes (80Hz)
1280 x 1024 NI	—	—	—	—	Yes (80Hz)	Yes (80Hz)	Yes (75Hz)
1024 x 768 NI	87Hz/1	80Hz/NI	75Hz/NI	75Hz/NI	75Hz/NI	75Hz/NI	75Hz/NI
Mac Compatibility	—	—	Yes	Yes	Yes	Yes	Yes
Flat Square	—	—	—	Yes	Yes	Yes	Yes
Color Match	—	—	—	—	—	Yes	Yes
Digital Controls	—	—	—	—	Yes	Yes	Yes
MPR-II & ISO8241-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power Savings	<30W	<30W	<30W	<30W	<5W	<5W	<5W

For full-time low power, no radiation and even more versatility, check out our handsome, new LCD monitors.

Their active-matrix displays provide bright, sparkling color (and b/w) even when viewed from wide angles. They weigh less than six lb. and can even be wall mounted.

For even bigger shows, our low-cost LCD projection panel can turn your whole wall into a computer monitor. It's flicker-free, shows millions of colors and comes complete with on-screen menus, freeze frame and enlargement capability, a patented overhead projector light blocker, wireless remote control and its own rugged carrying case.

More than one million CTX monitors were purchased by computer professionals in the U.S.A. last year. Call us today and find out why.



We just make great monitors.



For more information, contact the CTX regional office nearest you: **USA Headquarters** 20530 Earlgate Street, Walnut, CA 91789, 909-595-6146, Fax 909-595-6293 **Technical Support** 1-800-888-2012 **BBS** 909-594-8973 **Southern Region** 6624 Jimmy Carter Blvd., Norcross, GA 30071, 404-729-8909, Fax 404-729-8805 **Eastern Region** 481 Edward Ross Drive, Elmwood Park, NJ 07407, 201-646-0707, Fax 201-646-1998 **Midwestern Region** 500 Park Blvd., Ste. 295C, Itasca, IL 60143, 708-285-0202, Fax 708-285-0212 **Southwestern Region** 1225 E. Crosby Rd., Ste. A21, Carrollton, TX 75006, 214-416-9610, Fax 214-245-7447.

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You've never really
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them for everything. But
something inside you says,
"Databases? Programming? Whoa!"
Well, the new Lotus Approach
makes it easy as 1-2-3... Dive In.

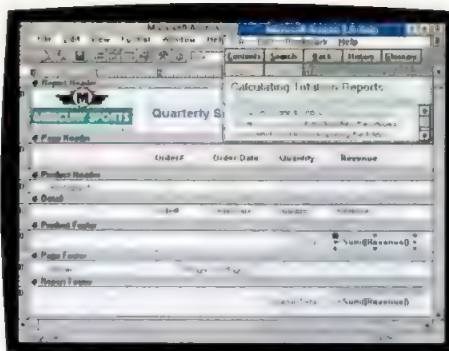


INTRODUCING LOTUS APPROACH® Release 3.0

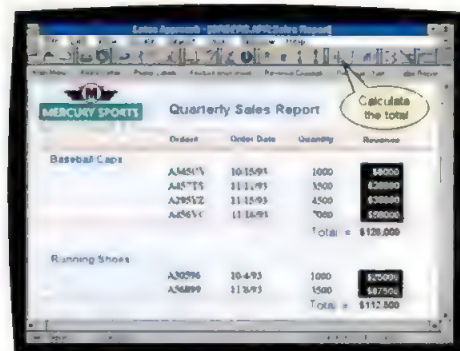
In 1983, Lotus® introduced the world's first approachable spreadsheet.

Now we introduce a truly powerful database that's as easy as 1-2-3.

Now you don't have to be a programmer, or even think like one, to



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build a relational database that brings real efficiency

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Over 200 new usability and power features will take you, yes you, from an over-worked skeptic to a productive database-user-for-life in two hours.* Don't doubt it. There's a good reason why Approach is the fastest-growing database in the business.

EASY AS 1-2-3

Lotus Approach is the only database that gives you PowerClick reporting, letting you see and alter your report as you are building it. Just click on the intuitive SmartIcons® to organize and

calculate your data. And, the friendly on-line Assistants help you to design your reports, forms, mailings, analyses and more. Compared to Access,® well there's no comparison. As *InfoWorld*

recently commented, "Approach (3.0) looks like a better choice than Microsoft Access (2.0): easier to use, yet still fast and powerful."**

In fact, Approach 3.0 extends the power of Lotus 1-2-3® allowing you to create intelligent forms, PowerClick reports, mailing labels, and dynamic crosstabs on your worksheet without ever leaving 1-2-3.

With Approach's X10 query technology, you get blazing speed in organizing, analyzing and manipulating your database. And, Approach gives you the highest performance connectivity to virtually any database, from Paradox® to Access, to Lotus Notes® and more. You also get a powerful new macro capability for sophisticated application development.

And its advanced integration with Lotus Notes, the leading groupware application, makes it the obvious choice for people who work together in groups.



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CIRCLE 311 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Learning Excel 5: The Short And the Long of It

BY RICARDO DOBSON

The release of Microsoft Excel, Version 5.0, generated a wide variety of books designed to help users get the most out of this popular spreadsheet. Some offer help in pocket-size doses, while others are full user guides with more than 1,000 pages. One of these four books on Excel 5.0 should be the right guide for your needs.

POCKET-SIZE HELP

Those looking for a humorous and helpful introduction to Excel 5.0 will be well served by Stephen Nelson's *Field Guide to Microsoft Excel 5 for Windows*. Nelson conveys basic Excel techniques in four complementary sections.

The graphics-filled Environment section starts the book with a summary of Excel's application window elements. The remainder of this section discusses worksheet layout, charts, list management, and workbook printing. The Excel A to Z section offers an alphabetical reference to more than 200 topics. Many summaries in this section include step-by-step procedures; definitions and procedures are often linked to one or more dialog boxes to make them easy to grasp.

The Trouble-Shooting section helps novices solve common problems. A summary of each problem precedes a selection of strategies for fixing it. Learn what

to do when long labels don't show, financial functions work incorrectly, or you can't find a workbook. *Field Guide* concludes with its Quick Reference section, which includes brief descriptions of worksheet and chart menus. A button guide reviews the purpose of tools on the standard, formatting, and charting toolbars.

Douglas Hergert bridges the gap between pocket-size reference manuals and full-scale guides with *Excel 5 for Windows Instant Reference*. This book focuses on the concerns of intermediate-level users. Hergert offers serious, in-depth coverage of 124 topics, starting with a summary of new Excel 5.0 features.

EXCEL TOMES

Running Microsoft Excel 5 for Windows, by The Cobb Group with Mark Dodge, Chris Kinata, and Craig Stinson, is the most comprehensive introduction to Excel. This book serves the needs of novice, intermediate, and power users. The book's most significant

strength is its thorough coverage of all Excel 5.0 features. Chapter 3, for example, reviews the File menu by explaining and illustrating nearly every command on it.

Five chapters organize functions into logical groups. Many descriptions include screenshots illustrating how functions work, and nearly all function summaries include an example. A See Also icon cross-references functions and provides other vital background information about how to use them.

The discussion of macro programming with Visual Basic, Applications Edition (VBA), extends over three chapters; they start by illustrating how to record macros and conclude with a review of VBA's object-oriented syntax.

Excel 5 Super Book, by Paul McFedries, targets the needs of intermediate and power users. A detailed table of contents and an expansive index ease the task of finding what you need in this reference's 1,133 pages. *Super Book* comes with a disk containing a collection of custom projects and The Baarns Utilities—a highly regarded collection of Excel add-ins. The book is broken up into workshops in which McFedries takes you from the basics to programming, custom menus, exchanging data with other applications, and more.

The beginning workshops reveal how to enter, print, chart, and analyze data. Two workshops cover programming (for a total of nearly 300 pages). The first reviews the Excel 4.0 macro command language along with its updates for Excel 5.0. Those who need to understand or maintain macros from previous Excel versions will find this discussion especially valuable. The second programming workshop introduces the VBA development environment.

The final workshop chapters review the eight custom projects. These projects are complete Excel applications for dealing with diverse tasks ranging from balancing your checkbook and forecasting sales to planning a trip.

► **Field Guide to Microsoft Excel 5 for Windows**, by Stephen L. Nelson, \$9.95. Microsoft Press, 800-677-7377. ISBN: 1-55615-579-4.

Circle 444 on reader service card

► **Excel 5 for Windows Instant Reference**, by Douglas Hergert, \$9.99. Sybex, 800-227-2346. ISBN: 0-7821-1325-7.

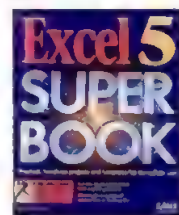
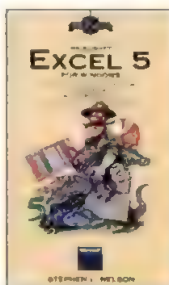
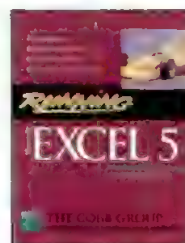
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► **Running Microsoft Excel 5 for Windows**, by The Cobb Group with Mark Dodge, Chris Kinata, and Craig Stinson, \$29.95. Microsoft Press, 800-677-7377. ISBN: 1-55615-585-9.

Circle 446 on reader service card

► **Excel 5 Super Book**, by Paul McFedries, \$39.95. SAMS Publishing, 800-428-5331. ISBN: 0-672-30385-X.

Circle 447 on reader service card



Read Only Recommends

Both seasoned graphics artists and Photoshop novices will benefit from Linnea Dayton and Jack Davis's *The Photoshop WOW! Book, Windows Edition*. The well-thought-out book is a concise guide filled with colorful step-by-step tutorials. \$34.95; Peachpit Press, 800-283-9444; ISBN: 1-56609-070-9.

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corporation. *Size and weight indicated are for the Contura Aero 4000, Model 84 and Model 170. Model 4000 pictured here weighs 4.7 lbs. *Batteries and certain options covered by a one-year warranty. Certain restrictions and exclusions may apply. **Aero product information, select document number 4010. *Estimated reseller price. Prices will vary. Model 4000 pictured here starting at \$2,189. The Intel Inside logo is a registered trademark of the Intel Corporation.

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Sony With Soul



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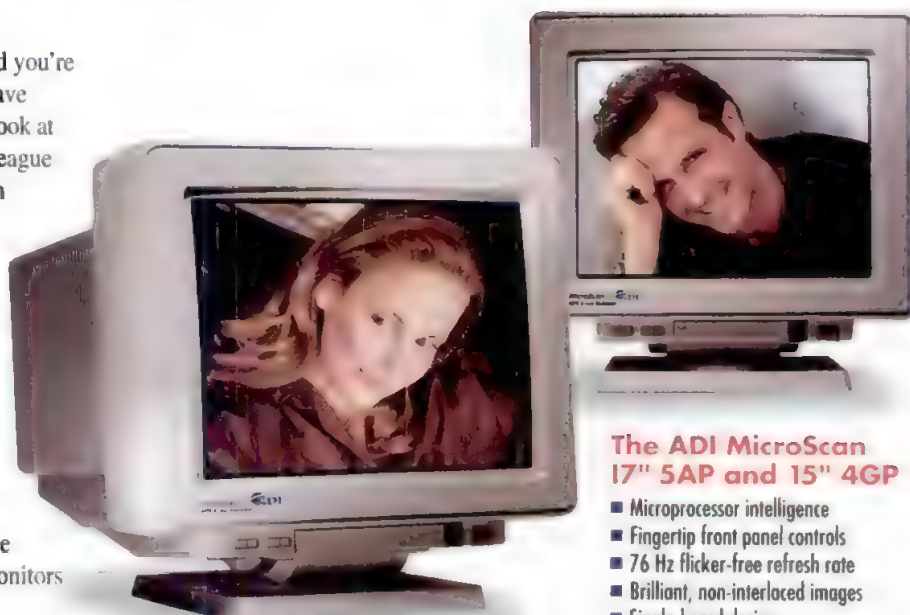
or exceeds every standard for manufacturing, power conservation, ergonomics and safety. That's why three million ADI MicroScan monitors have been sold.



March 16, 1993
ADI MicroScan 3E+

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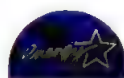
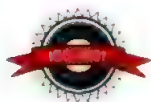


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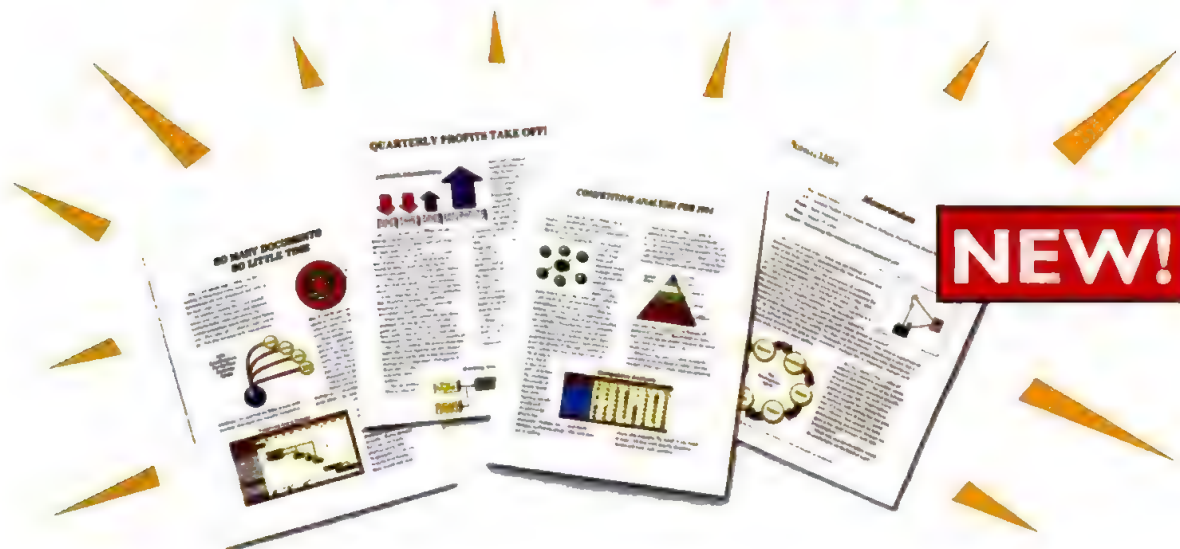
ADI Systems, Inc. 2115 Ringwood Avenue, San Jose, CA 95131

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— Windows Magazine, January 1994

You already know that adding graphics to reports, presentations and other documents makes them more interesting. More persuasive. But unless you're an artist or a computer genius, you also know that creating graphics has simply been too difficult and time-consuming. Until now.



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— Carolyn Beeley
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CIRCLE 361 ON READER SERVICE CARD



Michael J. Miller

IBM: Déjà Vu, or a Second Chance?

I'm listening to IBM's senior vice president of strategy and development, Jim Cannavino, explain how IBM is planning to revamp its operating-system strategy for the 1990s when suddenly it hits me: Haven't I been here before? No, I don't mean the

boardroom at IBM headquarters, with its U-shaped leather-topped table and thick gold carpeting. I mean that this isn't the first time I've heard IBM talk about an audacious plan to change what everyone expects from a computer operating system. Back in 1987, Cannavino and his company talked about the need for a graphical user interface and a more robust multitasking operating system. What they finally came up with was called OS/2. But while OS/2 has lots of technical advantages and a core of dedicated users, it hasn't gained the lion's share of desktops and applications. Microsoft Windows has.

A BRAND-NEW OPERATING SYSTEM

This time out, IBM's new operating system will be called Workplace. It will combine all sorts of previous IBM operating-system initiatives into a new and unified strategy. This is a tall order. The goal is to incorporate everything from OS/2 into a microkernel-based operating system, and then push toward object-oriented languages, IBM's System Object Model (SOM), and—finally—the Taligent Frameworks. Workplace should extend across a broad range of systems, including Intel-based PCs, PowerPC-based workstations, AS/400 minicomputers, and S/390 mainframes. We've heard about the Workplace strategy before (see "Two Paths Diverged," *PC Magazine*, December 22, 1992). What makes this endeavor different is that now it's not just the Personal Software Products division of IBM that's stepping out on a limb; it's the whole company.

At the heart of the Workplace system will be a single microkernel that will work on all sorts of hardware platforms. On top of this will be the equivalent of an old operating system (OS/2, AIX, or OS/400, with MVS possibly coming down

the line) and a set of common services. All of this will then be topped with the OpenDoc architecture and the Taligent Frameworks, giving us the underpinnings of individual applications that can be viewed together through a common desktop.

THE OBJECT IS OBJECTS

At the core of this strategy is a very aggressive move toward objects at every level. The job of coordinating the object strategy has fallen to Steve Mills, general manager of IBM's Software Solutions Division (SSD). He says the strategy uses SOM as its underlying object model. He notes that SOM is robust, is designed to be language-neutral, and complies with industry standards. A number of development environments will be used to build on SOM. These will focus on C++ and Smalltalk.

At a higher level of the system, the Taligent Frameworks (created by IBM's joint venture with Apple and HP) will make it easier to create large-scale "parts." The Taligent Frameworks, currently being rolled out to early developers, provides standard methods of doing common things, such as interacting with a user interface or creating a text editor.

OpenDoc is designed as a linking standard that combines parts to create compound documents and applications. As such, it competes with Microsoft's Object Linking and Embedding (OLE). IBM touts OpenDoc as being compatible with OLE and notes that it offers more advanced features—such as allowing for nonrectangular objects, objects on top of objects, and multiple active objects.

If all these levels of objects are confusing, think of them as boxes within boxes. An application is created out of lots of parts, such as text editors and various



IBM hopes its new Workplace will take a bite out of Microsoft's OS pie.

Michael J. Miller

tools. The parts are created out of applications frameworks, which in turn are created out of various class libraries. These libraries are typically written in object-oriented languages such as C++ or Smalltalk.

Individually, all of these pieces are interesting. But when you begin to consider them together, they do nothing less than entirely redefine the way we think about software. Instead of huge "mega-applications," you'll begin to see the development of smaller objects—ranging from those that control the user interface to those that handle work-group or enterprise functions.

A MORE OPEN VIEW

According to Mills, because Workplace will let customers reuse and connect common objects, customers will be able to concentrate less on the individual objects and more on their business problems. He foresees the ability to create programs rapidly and with more flexibility, perhaps with customers creating applications that last only a couple of

weeks but are still robust and dependable. As IBM tells it, this strategy offers a number of major advantages for customers.

Workplace will encompass hardware of all sizes, present a common look and feel across multiple platforms, take advantage of "open standards," and increase productivity via faster development cycles. It will also have other benefits: It will preserve some level of compatibility with today's applications while setting the stage for newer, more object-oriented applications in the future. It will let IBM consolidate many of its OS efforts on a single OS platform instead of continuing to create unique operating systems for each kind of hardware. And of course, it will give IBM a new edge in the company's continuing OS competition with Microsoft.

Nevertheless, tackling the Microsoft-dominated OS market is a big challenge, as IBM executives readily admit. IBM did a lot of things wrong in 1987. As Cannavino sees it, early versions of OS/2 were "doomed from the beginning" because they were aimed at 286-based PCs. The first versions of OS/2 merely fixed the plumbing—with things like multitasking and crash protection—rather than providing the end user with new capa-

bilities. IBM didn't help matters when it moved from focusing on a single complete suite of applications (OfficeVision) to offering no mainstream OS/2 applications.

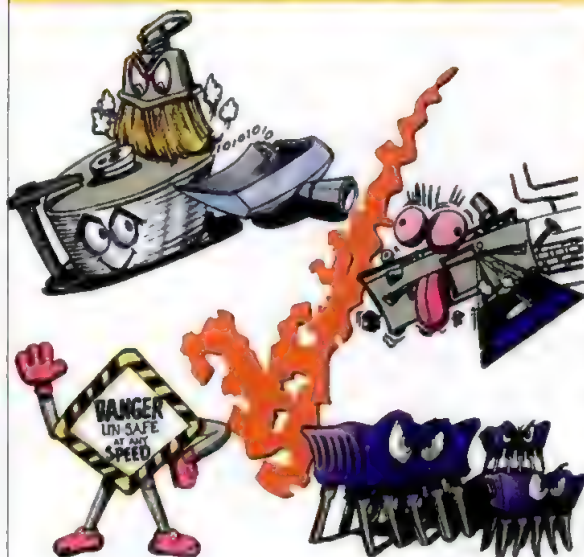
This time around, IBM has changed its stripes, Cannavino says. Workplace will target a range of platforms, with a special focus on the PowerPC. IBM will focus on how objects benefit users. Through SSD, it will create its own objects and applications. Meanwhile, it will continue to woo third-party developers.

One thing making it easier for IBM to change strategies this time out is the fact that it doesn't have the overwhelming market share it did seven years ago. It therefore can afford to take more chances. "Would I rather have an 85 percent share of the market?" asks Cannavino. "Of course. But we did, and we lost it." Now IBM believes it can move faster and thus gain back market share from Microsoft. But IBM isn't kidding itself, Cannavino says, adding, "It won't be easy."

Remember what George Santayana said: "Those who cannot remember the past are condemned to repeat it." Whether or not IBM can pull this off is still an open question, but there's no doubt that the company remembers the past. □

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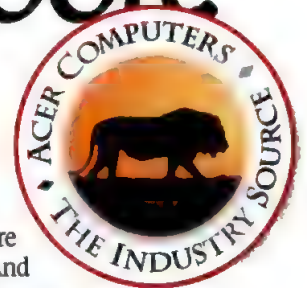
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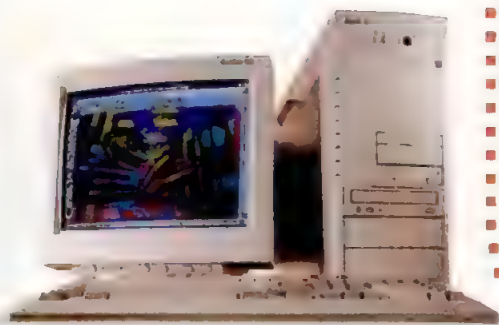
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An Embarrassment of Riches

Pointing devices have reached a plateau of competence. The rule of thumb for choosing one has continually evolved; it used to be "Use what works." Then it was "Use what works for you." Now it's "Use what works best for your application."

For everyday desktop operation, nothing beats the mouse. Everybody understands the relationship of mouse movement to cursor movement, despite the occasional story about the person who turns the mouse upside down and uses it as the world's most awkward trackball or the person who aims it at the screen and clicks, as if it were a remote-control device.

Of course, the mouse has always had its detractors, since it requires you to remove a hand from the keyboard to use it. Complaints notwithstanding, were it not for the advent of portable computers, there would be little reason to go beyond the mouse for normal use.

The mouse has never been a comfortable companion to a notebook. The extra hassle of an external cord, along with the search for a flat area, has driven most notebook manufacturers and users to the trackball. The captive mouse on Hewlett-Packard's OmniBook is a notable exception, but I dislike the flimsy feel of the thing. If you insist on using a mouse on the road, the only one to have is Appoint's Gulliver mouse. Its short cord and small size make it a natural. It's fussy about the surfaces it will roll on, but a Post-It note is all the mouse pad you'll need.

The trackball is the hands-down winner for sheer popularity on laptops. Trackballs scale fairly well, and a marble-sized trackball is still workable and takes little room in the machine. A small percentage of users has always preferred the trackball for desktop use as well. Desktop trackballs tend to be more the size of a billiard ball; they have significant mass, and inertia helps their feel. Laptop trackballs have no inertia, and some are so light that the slight stickiness of your thumb or finger moves the trackball as you let it go.

The Logitech and Microsoft add-on trackballs for portables have been

okay, but my current favorite add-on trackball is Logitech's TrackMan Voyager. This little honey can mount on the front or side of most any machine and has both a great feel and the most clever mechanical engineering I've seen yet. It adapts well to machines of widely varying thicknesses. Center-mounted trackballs like Apple's have the advantage of allowing you to keep your hands on the home row. The least usable implementations are the ones where the trackball is located next to the screen. They require a large, uncomfortable hand movement involving rotation as well as reaching.

Using trackballs can be a dirty business, though, because our finger oils make them magnets for work-gumming dust. Some people report having to clean their trackballs as often as every two or three days.

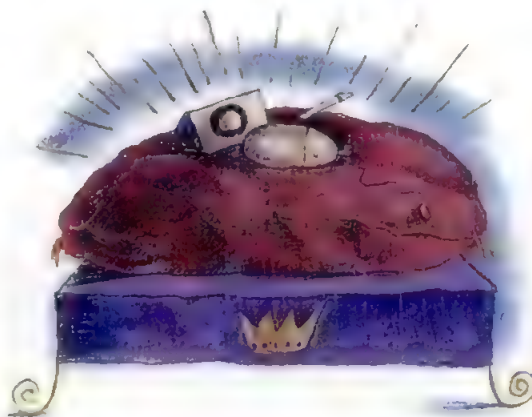
RETURN OF THE TOUCH PAD

Apple's PowerBook has probably done more than any other notebook to popularize the trackball on portables, and the new 500-series PowerBooks are in the vanguard once again with touch-sensitive panels. This idea has been around a long time, but never before have both the ergonomics and full integration happened simultaneous-

ly. These machines are superb. There's the first pointing technology that feels as natural to use as the mouse yet is considerably more sophisticated. The touch pad's ability to move a character or a pixel at a time or zip the cursor across the screen in response to an input as gross as a swipe of the side of your thumb is amazing. Expect to find this technology on the Windows side of the world soon.

SOMETIMES A GREAT NOTION

Pen computing, meanwhile, isn't dead. It isn't even sleeping. It's alive and well



The mouse and trackball have plenty of competition, especially in notebook machines.

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CIRCLE 330 ON READER SERVICE CARD

Bill Machrone

in vertical markets, where it belongs. Some harsh realities have intruded on the pen makers' grand plans to take over portable computing: Handwriting is still slower than typing; there's no point in using a stylus where a finger will suffice; and handwriting recognition today has just enough imprecision to infuriate users. Meanwhile, pen-and-digitizer combos are prospering on the desktop, spurred by the graphical power of current-generation hardware and the enormous surge in popularity of painting-oriented programs. Whether you're creating new images, manipulating existing images, or retouching photographs, the pen is mightier than any other pointing device.

Those little rubber pointing sticks have made their point, too. IBM took the lead on the ThinkPad line, demonstrating that a well-integrated pointing technology makes a great machine even better. The technology has shown up on some Toshiba and Texas Instruments models, too, as well as on my Gateway HandBook 486. The HandBook's feel, however, is a notch below the excellent feel of the IBM's. It's easy to overshoot your mark, especially when attempting delicate movements.

POWER USERS' J KEY

Along the same lines as the pointing stick is another new/old idea. The J Key has been around for a while, and it is in some ways similar to the pointing stick. Under the J key is a set of strain gauges that record your finger motions. If you press and hold the J key, it "swallows" the character it just generated and turns itself into a cursor control. You never lift your hands from the home row, which is a big advantage for fast typists. The J Key sounds as if it would be weird, but it works surprisingly well. It's as easy to adapt to as a pointing stick and easier, in my book, than a trackball. The J Key redefines a number of left-hand keys to perform mouse-oriented clicks, selects, drags, and inserts. Power word processing and spreadsheet users will wonder how they got along without it. The J Key is available on a standalone keyboard and in Zenith Data Systems' new Z-Star EX notebook.

The state of the pointing-device art is finally good enough that it enables you to be fully productive. You can interact at the highest possible level with any application at any level of computing, from desktop to sub-notebook. It's about time. □

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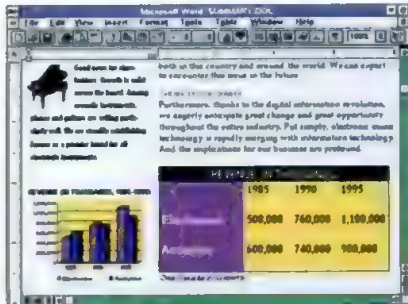
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CIRCLE 038 ON READER SERVICE CARD



John C. Dvorak

The Lessons of a Dusty Turntable

Don't be fooled into believing that we're forever tied to the Windows/Intel platform just because there's a critical mass of applications written for it. After all, unlikely platform shifts have happened in the past. Just recently, in fact, the entire world shift-

ed from the vinyl record to the compact disk. When compared with the hundreds of millions of vinyl records that were made obsolete practically overnight, the installed base of software running on the Intel platform is small potatoes.

Ever since my visit with some Pentium engineers, a comment made by one of the top Pentium designers has been bothering me. He told me that his designer friends, critical of complex instruction-set computing, always say to him, "How can you endure designing chips with the burden of all that old code out there that you've got to maintain compatibility with?" He would always tell them that the old code was no burden. It was a benefit—even an unfair advantage. His rationale was that the old code base assured any future chip design instant success. The current proof of his thesis: We all want a fast Pentium computer, don't we? And next, we'll all want a P6 machine.

The prevailing notion is that the huge, entrenched application base out there will make a platform shift impossible. Back in 1981, it was easy to give up a CP/M machine for a PC because there weren't that many CP/M machines to give up. (Of course, this argument meant little to the CP/M machine owners who had to give them up.) I'll accept the fact that the bigger market of 1994 has more momentum and will be harder to change than the market of 1981. There's also reason to believe that even if the PowerPC—the platform-change chip of choice—is clearly superior to the Pentium, the market will choose the Pentium. History has shown us how superior products can fail, for a variety of reasons. Just look at the Amiga in its day. And let's not forget that IBM has been better at fumbling the ball than scoring touchdowns. Today,

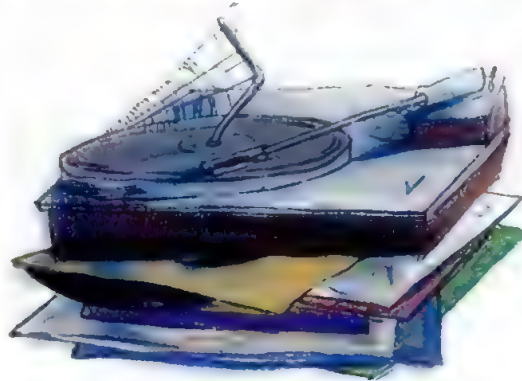
however, IBM is running the PowerPC show (see this issue's Inside Track).

With Windows 4.0 (Chicago) about to be released and Intel stepping up its performance with new cool-running, hot-performing Pentium chips, a platform shift seems unlikely. But right into the midst of these changes comes the PowerPC.

What real-world model is there for a successful platform shift under these circumstances? Just as the CD revolution began, the vinyl engineers had perfected special mastering techniques to push their technology forward. Stereo 45s were finally a standard, and DBX-encoded vinyl records were appearing on the market. Everything looked rosy. I can imagine what the executives of turntable companies were saying to their shareholders. "There are too many vinyl records out there. People aren't going to replace all that vinyl with CDs." It's hard to imagine that a solid industry like the vinyl-record industry would disappear almost overnight. I recall going to my local Tower Records one day, expecting to find the usual vinyl shop with some CDs scattered about. I walked in and was floored by the change—100 percent CDs.

If I were at Intel or Microsoft or any computer company locked into a set of beliefs that reject the possibility of a platform shift, then I would study the fall of the vinyl record and the sudden emergence of the compact disk. The shift was the result of pent-up demand for something better. Today there's pent-up demand for a new PC architecture. I'm tired of this old PC AT design (happy tenth anniversary this month!), no matter how fast it runs.

The platform shift of 1981 is an act that can be repeated. Don't let them kid you into thinking otherwise.



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CIRCLE 083 ON READER SERVICE CARD

Inside Track

Following the PowerPC Dept.: I'm told that there's a **warehouse full** of PowerPCs ready to ship as soon as IBM finishes the operating system. **Details:** The machines are **black** and the company had them specially designed to look hot and **futuristic**. If true, this would be a departure for IBM.

There are three lines of machines. Desktop and minitower models make up the traditional line, but IBM is also designing something it's calling a **bookshelf computer**. The bookshelf system, which is about the size of a ThinkPad, is designed to be used with a **port replicator** similar to the ones that go with the Toshiba Portégé and the current ThinkPad. IBM calls this replicator a poor man's docking station. The bookshelf-style machine (epitomized by the Cary-1) is **nothing new** to people who keep an eye on trends in Asia. You can easily fit it in a briefcase and haul it from place to place. **Shades of the Ergo Brick.** The final line is a series of PowerPC-based ThinkPad notebooks.

The desktop units will use the **PCI bus**, and the totally new BIOS works with a so-called **bus bridge** that lets the new PowerPC interface the PCI bus with both ISA and Micro Channel buses. In theory, **cloners** could actually make cheap ISA-based PowerPCs.

While there has been a lot of chitchat over an **unconfirmed version** of the PowerPC dubbed the 615 (it **incorporates a 486 on the chip**), people who've played with the **software emulation** say that the PowerPC machine can run 486 programs at 66 MHz right out of the box. I've never seen a decent emulator, but I know that **it's possible** to make one work at decent speeds. I'm told by yet another source that the **DOS compatibility box** within the Workplace OS runs DOS even faster than OS/2's virtual DOS machine (VDM). The DOS within OS/2 is considered by nearly all DOS fans as the **best and fastest DOS** on the market.

IBM's use of the PCI bus in the PowerPC box marks the **end of the line for EISA and Micro Channel** buses, and probably the VL-bus, too. While the VL-bus is clearly the best bet for the 486 world (no matter what they tell you about 486 PCI machines), there's no evidence that the VL-bus can sustain any **momentum** to the end of this year.

Another **interesting aspect** of the PowerPC is that it gives the second-tier companies another shot at the top. Taiwan's Mitac comes to mind. Here's a company that was number one in clones out of Taiwan until it was passed by Acer. **Acer has committed to the Pen-**

*I'm told there's a warehouse
full of IBM PowerPC
machines just waiting
for an operating system.
Rumor has it that the
machines are black,
and IBM had them specially
designed to look hot
and futuristic.*

tium and has been toying with the MIPS chip for a workstation solution. Last year in Taiwan I asked upper management at Acer about its plans for the PowerPC. They said they had none, but felt they could **move fast** if the PowerPC suddenly became the hot ticket. In other words, the chip isn't being ignored by the top tier.

Anyway, Mitac and other Taiwan-based cloners stuck in the Acer shadow are going head first into the PowerPC arena. The big American firms are being very **close-mouthed** about their PowerPC plans. The biggest companies—vendors such as Compaq, Dell, and Gateway—have to be careful about **angering Intel**, the sole supplier of the Pentium. So there are **no**

PowerPC boosters from these camps. Gateway is getting its Pentium motherboards from Intel, and Dell is glued to Intel. (Michael Dell was an expert witness for Intel in a case against AMD.) Compaq's been on shaky ground with Intel since its investment in the NextGen chip developer, but recently Compaq's Eckhard Pfeiffer made a public pronouncement praising the Pentium and eschewing the PowerPC. He's back on the A-list, I'm sure. Since last year's Innovations trade show (sponsored by Compaq for its dealers and supporters), where Andy Grove was a keynote speaker, the two companies seem rather close.

If the PowerPC draws a crowd—and it's likely to do so—we may end up with a New World Order. The last time there was a platform shift **the big names** in the desktop business computer scene were CompuPro, Cromemco, Heathkit, Morrow, Northstar, Osborne, and a dozen other companies you've **never heard of since**.

So how will IBM screw up the marketing of these hot PowerPCs? 1) It can **overprice the machine**. This mistake is almost guaranteed as far as I can tell. If the cloners are up to speed, though, this won't last and may not cripple the machine's acceptance. 2) It can **ignore** video trends. I was chatting with the Nokia people, and they see a **surprising move** to 21-inch screens with 1,600 by 1,200 resolution. Despite welcoming the graphical user interface, IBM seems **unwilling** to notice that high-resolution screens are an aspect of the GUI revolution. We should accept the fact that 17-inch monitors running 1,024-by-768 are the minimum accepted display specifications. Fewer than 256 colors is a **joke**. I can just see IBM rolling out this machine with 640-by-480 with 16 or 64 colors. 3) Promote them as servers! This will sink the systems for sure. □

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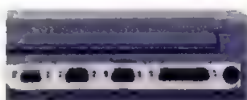
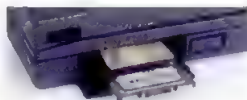
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Jim Seymour

Wireless Wonders

Mobile computing is one of the hot spots in the PC business right now—red-hot, in fact. Using our portable computers just as easily away from our offices as when we're there—whether we're in a conference room down the hall, on the road,

or maybe sitting in the stands at a baseball game—is a powerful and seductive idea.

It's also an enormously important part of the future of computing. Not interested in toting around a notebook or subnotebook? You will be someday. When you do, you'll find that machine to be so much dead weight much of the time unless it can make contact with other computers—for accessing e-mail, accessing files on your desk at work or home, entering customers' orders or checking on existing ones, or looking up information in remote databases.

And you won't be willing, I promise you, to put up with the indignities of trying to find a conventional land-line telephone through which you can make that connection. Wireless links are essential to mobile computing.

In the office, wireless LANs allow quick, easy setup of new nodes without the need to pull up the floor, baseboard, or ceiling to fish new wires. Even better, they allow users to wander within a certain area, carrying a notebook with them, still connected. *Ubiquitous computing* is gaining favor as a catchall phrase for the idea that you should be able to use your PC anywhere within a building or cluster of buildings, staying connected as you go.

We're not there yet, but we're getting close. And you can sample a very useful taste of that kind of wireless, mobile computing right now. First, though, you may have to reset your expectations.

RELATIVELY POKEY

Anyone accustomed to the performance of today's networks needs to shift gears to appreciate the usefulness of many of today's wireless systems. If you're used to the 10-Mbps speed of Ethernet or an even faster

Token-Ring network, the relatively pokey data-transfer rates of some wireless systems might convince you that they're not yet ready for serious use.

You'd be wrong. But I know the feeling.

A couple of years ago, I set up a wireless LAN using Proxim's first-generation RangeLAN Ethernet cards. They took 20 times as long as the wired Ethernet LAN I was accustomed to, and I quickly decided they were just toys, not tools.

A couple of days later, it dawned on me that I'd missed the point. We had set up a several-station LAN in just a couple of hours. We hadn't pulled a foot of cable, and we had machines hundreds of feet from each other chattering away without a hitch.

Wireless networking was, I realized, *convenience* networking, not high-speed networking, and in the LAN business, convenience is never to be treated lightly. Moreover, since most network traffic today is still for file transfers and printing and not remote execution of server-resident programs, slower speed is a perfectly acceptable trade-off for the convenience and economy of wireless connections. I quickly hooked things up again and was soon marveling at what I'd scoffed at two days earlier.

I went on to persuade a number of clients that wireless LANs—or more often, wireless extensions to existing wired LANs—sometimes made sense for them. An obvious example is the lone-wolf PC isolated off in the shipping department, nowhere near any point to which you've pulled network cable, that suddenly *has* to be on the network.

More: When you've got to get a new employee up and working fast in an area where you haven't run cable, there's nothing like a wireless LAN. And when you've got to get a whole



Wireless LANs are more than just playthings. They're effective problem solvers in many situations.

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CHILD FIND OF AMERICA INC.



Jim Seymour

new crash-it-through minidepartment up and running fast—say, in 24 hours—we're not just talking convenience, we're talking survival.

Still more: When you're setting up a very temporary network—say, a network for a pressroom, a political campaign, a team of CPAs in for an audit, or a road-show operation where you need instant LANs in 10 cities in 12 days—there's nothing, absolutely nothing, like a wireless network.

But you don't have to get into full-function wireless LANs to appreciate wireless connections.

AN EASY WAY TO START

For \$250, you can buy Traveling Software's AirShare kit, part of LapLink Wireless, which lets you link two PCs for nearly effortless file transfers and printing on a printer connected to either machine.

This is genuinely cool hardware and software, but it's not just for the techno-weenies among us. Two light and tiny transmitter/receivers connect to the machines' serial ports, and very good Windows software gets them talking. Using spread-spectrum radio, AirShare supports transfer speeds of up to 115,200 bps. With three switch-selectable frequencies, you can use several AirShare units in the same area without interference.

Its Remote Access software, with a genuine Windows interface much cleaner than what you find in Traveling Software's LapLink packages, can do automatic-update synchronization between a desktop and a portable (or two desktops or two portables). When one PC comes within 30 feet of the other and both are turned on, they automatically start swapping files according to file-creation dates and times or using other rules you set up.

It's impressive, but AirShare has even more uses—from two-PC networks to setting up new machines to backing up a notebook's hard disk onto a desktop's tape drive to installing software on a diskless notebook.

Not long ago I was talking with a friend about wireless computing and mentioned AirShare. He'd seen the ads but wasn't interested; it was, he said, a trivial use of wireless connectivity. Trivial, phooey: This is seriously wonderful stuff.

And an enticing whiff of what's to come. □

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The Critics Rave

Hardly a month goes by when a Micron PC doesn't pick up a new award or citation: recently, Micron's P90PCI Powerstation earned *PC Magazine's* prestigious Editors' Choice Award and Micron's superb reputation earned them *PC Magazine's* Readers' Choice Service & Reliability award. *Byte*, *PC World*, *Windows Sources*, and others have also cited Micron PCs for technical excellence and exceptional value.



The Editors Marvel

"The system's components and general design dazzled,"—*PC Magazine* June 28, 1994. The P90PCI PowerStation outscored all of the competition—including Dell and Zeos Pentium PCs—in the Winstone 94, Disk Winmark and Disk benchmark tests. This was no surprise, however—in the April 26th issue *PC Magazine* also ranked the Micron P90PCI above all the competition in key benchmark tests.

The High-Performance/Value Leader

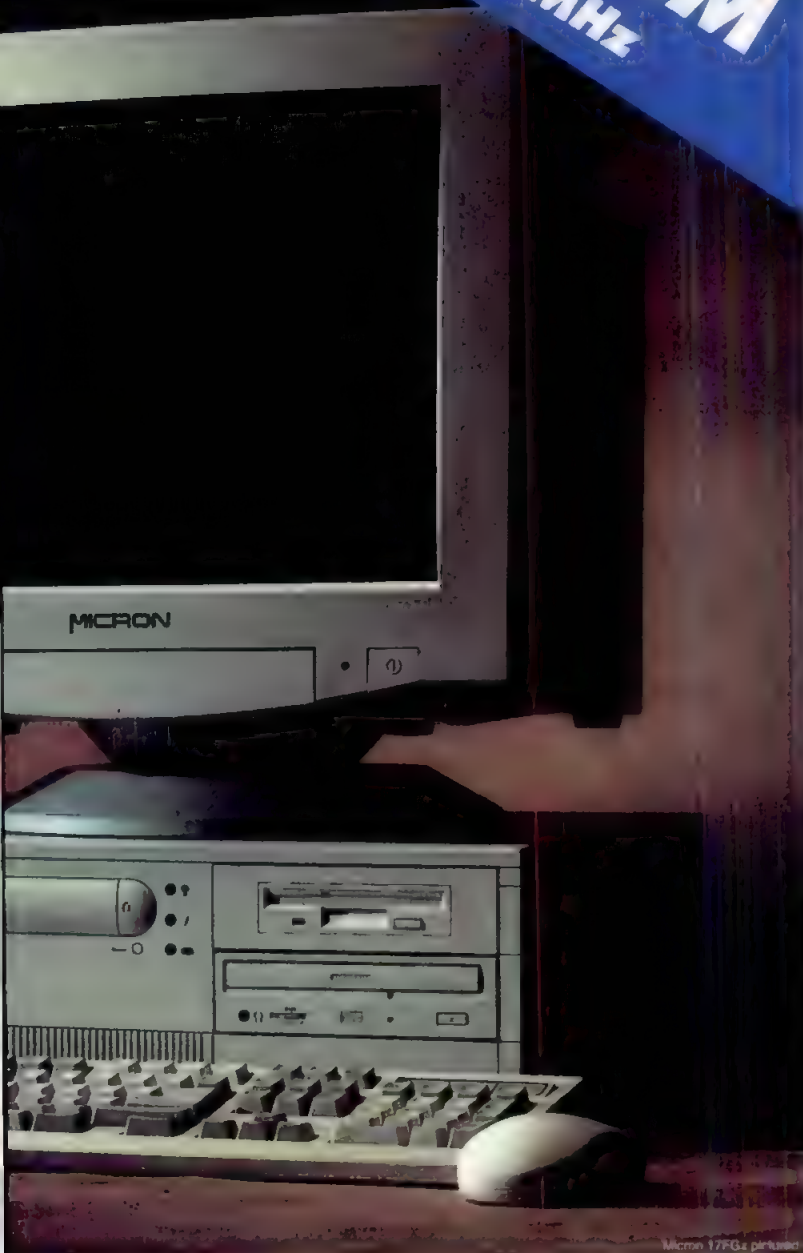
As a fully integrated manufacturer of semiconductors and components, Micron can offer the latest configurations at the lowest prices, and still provide outstanding customer service and technical support. "If value is paramount, the Micron P90PCI offers all you'll need in higher order computing,"—*PC Magazine* June 28, 1994.

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90MHz**



Micron 17FGx pictured



June 1993



June 1994



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June 28, 1994
Micron P90PCI
Powerstation

"...the Micron P90PCI combines an excellent design with quality components to create a powerful Windows machine."

PC Magazine 6/28/94

P90PCI Powerstation

- Intel™ 90MHz Pentium™ processor
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- 2X CD-ROM drive, 3.5" floppy drive
- 4 ISA, 2 PCI, 1 ISA/PCI, Flash BIOS
- PCI graphics accelerator (2MB)
- Desktop "Tool-Free" chassis
- MS Mouse, 101-key keyboard
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- Microsoft® Office 4.2 CD*



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Over and over, Micron is consistently ranked highest in overall customer satisfaction:

PC Magazine 1994 Readers' Choice Service & Reliability Awards gave Micron the highest ratings in the categories of Overall Reliability, Satisfaction with Technical Support and Future Likelihood of Buying Again.



Quality Keeps Them Coming Back

As a leading manufacturer of memory chips and computer components for over fifteen years, Micron offers a superb combination of technical superiority and high reliability, then backs its PCs with a knowledgeable and responsive technical support organization.

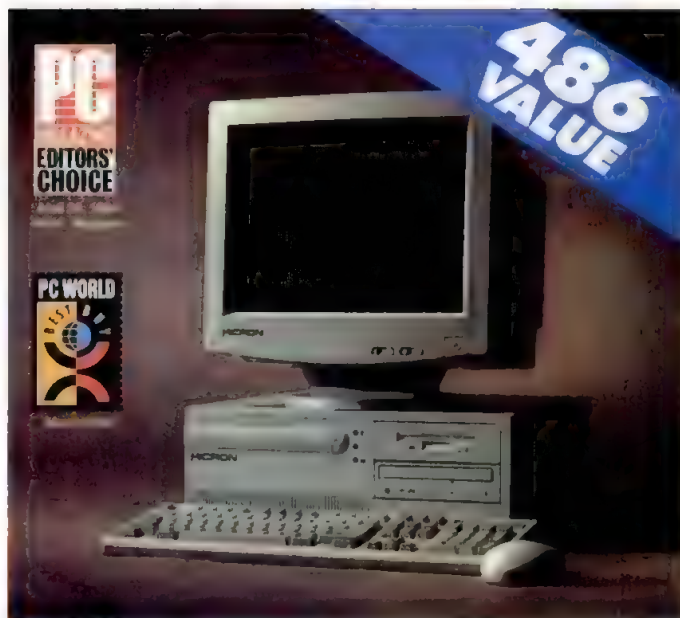
The Intelligent Choice

Smart buyers seek the highest performance for their dollar: "The 466VL came with everything we've come to expect in a high-performance machine," wrote *PC World*. Not surprisingly, Micron customers are more likely to purchase again than any other manufacturer.

433 Magnum LP

- Intel™ 486SX 33MHz processor
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- Low profile chassis—NEW!
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- Microsoft Works for Windows

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- "Once in a while a company really hits all the hot buttons for PC buyers."
- "Micron Computer gets high performance from quality components and thoughtful design."
- "The Micron 466VL Magnum CD was easily the best Windows performer."

PC Magazine April 26, 1994

466PCI Magnum

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- 4 ISA, 2 PCI, 1 ISA/PCI
- 2X CD-ROM drive, 3.5" floppy drive
- Desktop "Tool-Free" chassis
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups



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- PCI graphics accelerator (2MB)
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- Microsoft Office 4.2 CD*

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486 Family MPC

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- MS Works Multimedia CD*, Encarta 94 CD, Quicken CD
- Trial subscriptions for CompuServe, America OnLine & Prodigy
- 3 Lucas Arts CD games: Rebel Assault, Indiana Jones & Day of the Tentacle

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- Intel 486SX 33MHz processor
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B

- Intel 486DX2 66MHz processor
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P90 Family MPC

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- 16-bit sound card, speakers & joystick
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- Desktop "Tool-Free" chassis
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
- MS Office Multimedia CD*, Encarta 94 CD, Quicken CD
- Trial subscriptions for CompuServe, America OnLine & Prodigy
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- PCI graphics accelerator (2MB)
- Desktop "Tool-Free" chassis, 3 fans
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
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- 3.5" floppy drive
- PCI graphics accelerator (2MB)
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- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
- Microsoft Office 4.2 CD*

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All upgrades available with system purchase only.





Bill Howard

Happy High-Performance Holidays

There's good news and bad news for the holiday season. The good news is that you'll be able to buy a Pentium-based multimedia PC for \$1,995. The bad news is that it will be a 60-MHz system. But that's not exactly "Killer Hurricane Rips Populous Main

land" bad news, is it? Intel's big push this year is Pentium, for reasons of both Moore's Law (Intel cofounder Gordon Moore says CPU power doubles every 18 months, and he's right) and TWD (total world domination). Intel has never been happy with other chip manufacturers cloning its 386- and 486-class CPUs, and it's nervous about the PowerPC challenge from Apple, IBM, and Motorola. So Intel will follow a tried-and-true business adage: Cut prices today and you undercut your competition—legally.

PENTIUM AT HOME

Customers obviously benefit when a vendor cuts prices aggressively. Still, you ought to know the script for this story: Intel wants to unload, at fire-sale prices, its 5-volt 60-MHz Pentiums without cutting prices as much on its 3.3-volt 486DX4/100, Pentium/90, and Pentium/100 processors—the CPUs just above and below on the performance spectrum.

A sub-\$2,000 price for a system with a Pentium CPU, CD-ROM drive, sound board, speakers, big hard disk, and SVGA monitor does wonders to sell products into the home market. And it's in the home that Pentium provides the most noticeable performance boost. While word processors and spreadsheets feel pleasantly faster on a Pentium than on a 486, today's games don't begin to feel acceptable until you hit the Pentium level. Pentium's place is in the home, except for the price, and Intel is obviously working on that.

Intel is also working with game makers to put "This Game Prefers Pentium" or "Runs Best with Pentium" logos on game boxes; either slogan sounds better than "Bloated Code on Board—Needs Fast CPU." Intel says there won't be any code that precludes Pentium-class CPUs.

I have two concerns about a "Deck the Halls with Pentium" campaign. First, computer development has moved away from the gas-guzzler 5-volt technology that is the underpinning of the 60-MHz (and related 66-MHz) Pentium CPU. So you could be getting outmoded system components—given that a product's lifetime these days can be an astonishingly short six months. The motherboard might lack a high-speed serial port, or the BIOS might not be readily upgradable to Plug and Play technology.

My second concern is this: You won't be getting a low-power Energy Star system, because 5-volt CPUs draw too much power. The Energy Star program calls for the CPU system unit and monitor to burn no more than 30 watts each when idle. While the EPA allows crosstown smokestack industries to trade pollution credits as long as the total doesn't exceed a combined cap, in its prissy wisdom it won't let a monitor lend energy savings to a system unit. That means a 60-watts-at-idle system comprising a 10-watt monitor and 50-watt system unit (attainable on a 60-MHz Pentium PC) won't qualify, and most vendors won't do any power-conservation work unless they can get Energy Star approval.

So what should you buy? I wish there were a desktop 3.3-volt 75-MHz Pentium chip that would allow for a \$2,200 holiday system, but so far this CPU is aimed at portables only. If you want the best bang for the buck, take advantage of the distressed-goods sale and get a 60-MHz Pentium. If Energy Star compliance is important to you, get a 486DX4/100 system, but don't expect to pay less. If performance is important to you, spend an extra \$500 and buy a 90-MHz Pentium. In the long run, you're better off with a 3.3-volt CPU. □



Want to get a multimedia Pentium PC? Want to spend less than \$2,000? This fall you can do both.



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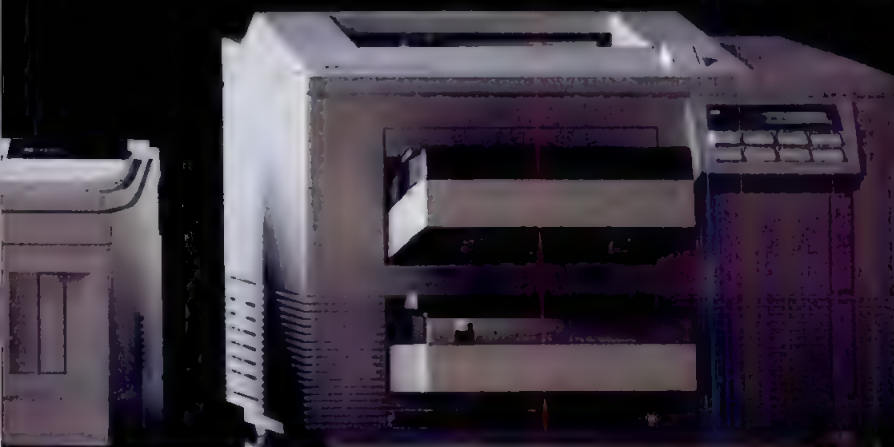
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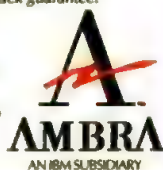
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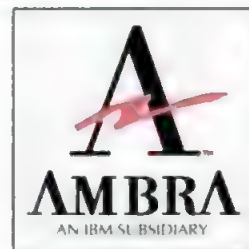
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Desktop model shown. Mini-tower and other configurations also available.

1800-200-1464

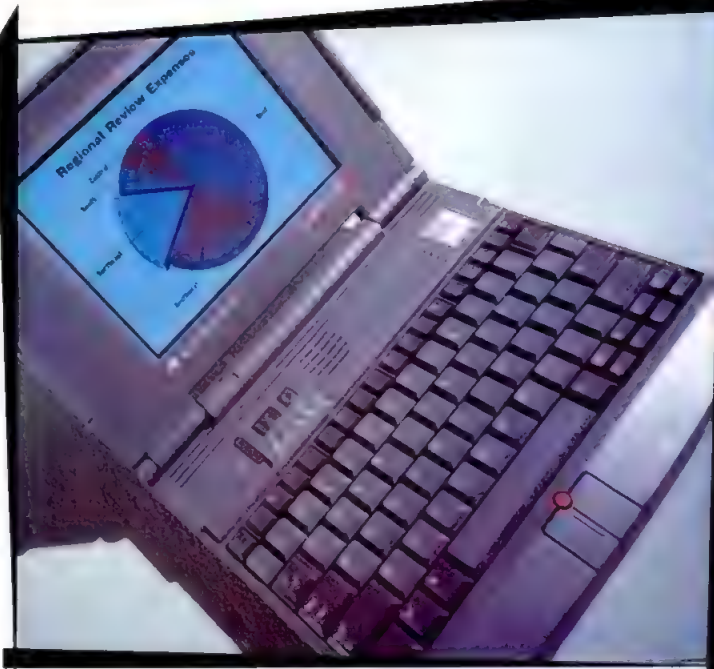
be available in certain locations. Offerings may differ in Canada. Prices do not include shipping. Return shipping and insurance charges are the responsibility of the customer. ¹AMBRA results independently tested 3/31/94. ²From PC Magazine, December 7, 1993. ³Limited time offer expires 8/31/94. Applies to 60MHz or faster processors. ⁴All manuals are on the CD. Printed manuals can be purchased directly from Borland® and WordPerfect®.



NOTEBOOKS

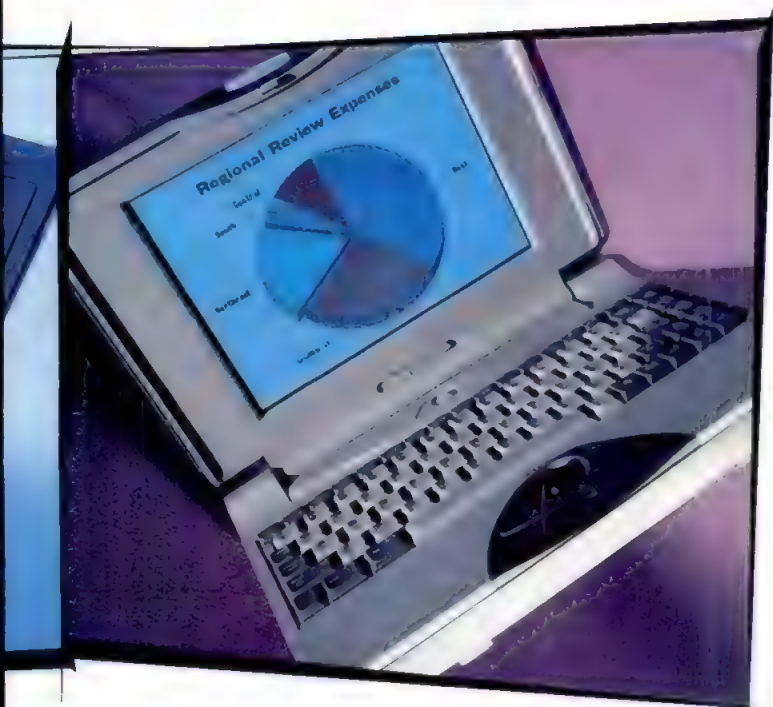
There is an embarrassment of riches in today's notebook market, with at least one system for every need and budget. *PC Magazine* tests 70 notebooks.

The Spectrum





of Choice



By Bill Howard

As notebook sales climb, accounting for nearly one-quarter of all PC sales, many users are shifting from the question of buying a notebook to the question of which notebook to buy: a full-fledged unit with desktop pretensions, a value-priced system, or a featherweight subnotebook.

The notebook market has divided into three distinct segments based on performance, features, size, and—most important—price. Each division targets a specific user profile. The mobile professional who's out of the office more than in requires a high-powered system, maybe with a presentation-quality active-matrix color display; increasingly, this class of system includes built-in sound and sells for between \$3,500 and \$5,000. For users

who travel just enough to need a portable, there are value-priced notebooks with monochrome or dual-scan passive-matrix color screens and reasonably sized hard disks that sell for \$1,500 to \$2,500. For the road warrior who travels frequently and whose portable is a vital tool augmenting the desktop PC, there are 4-pound sub-notebook systems that range from \$1,000 to \$5,000, depending on CPU and features.

Whatever their profile, users increasingly opt for color. Color first appeared in 1991 and now outsells monochrome; some vendors are even dropping monochrome displays from their high-end note-

book lines. The technically elegant active-matrix monochrome display, used by Apple and Compaq, is all but a dead end: For the same price, you can have dual-scan passive-matrix color.

SMALL WONDERS

The 70 notebook and subnotebook computers reviewed in this issue are tremendous feats of miniaturization and technical integration. The technology changes so rapidly that if you haven't been shopping for six months or more, you'll be amazed at what you find inside these systems.

- Color units dominate, and many weigh just 6 to 7 pounds; monochrome units

of the 70 systems; 33-MHz 486 variants (SX and DX) were also popular, accounting for 21 systems. In last year's reviews, the 25-MHz 386 and 486 CPUs were the most common. This year, 7 systems used the DX4/75 processor and 2 had the DX4/100. These chips place notebook PCs only one step below Pentium-level performance.

Choosing between the DX2/66 and the DX4/75 is hard: The DX2/66 connects to a faster system bus (33 MHz versus 25 MHz), but the DX4/75 has a bigger internal CPU cache (16K versus 8K) and a faster processor core (75 MHz versus 66 MHz). As a result, the DX2/66 had an average 4 percent advantage in processor power, while the DX4/75's average Winstone 94 score was 9 percent higher. (The better graphics subsystems in the DX4-based systems likely also contributed to this difference). The 3.3-volt DX4/75 may have a slight advantage over the 5-volt DX2/66 in terms of battery life. With performance about equal, price is the key differentiator: DX4/75-based notebooks sell for about \$1,000 more than comparable DX2/66-based systems.

The biggest disappointment continues to be video performance. Desktop PCs with hot graphics accelerators are returning Graphics WinMark scores of about 25 million pixels per second. By contrast, none of the 70 systems here even managed a score of 8 million; the average of the DX2/66-based systems was a meager 5 million. Even in a notebook with an active-matrix screen, really fast graphics chips are limited by the LCD display: If images move too quickly, there will be smearing. So vendors may argue, "Why bother?" The reason to bother is that many systems are attached to external color monitors, and users want fast video. Some vendors are listening; many systems contain local-bus video and laptop-tuned fast video chip sets, most notably the Western Digital Rocket chip.

THE PERFORMANCE GAP

Overall performance wasn't much better. The DX2/66-based systems had an average Winstone score of 37, compared with an average score of 50 for DX2/66-based desktop systems—a difference of 26 percent between desktop systems and notebooks. This performance gap is the result of three major factors. First, notebooks are likely to be equipped with 8MB of RAM rather than the 16MB desktop configuration.

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weigh about a half pound less.

- About one-third of the systems have a 486DX2/66 processor; a handful have a DX4 CPU.

- A 200MB hard disk is the entry-level norm, and 340MB is routine; 510MB to 810MB hard disks have just become available.

- Built-in pointing devices and PCMCIA sockets are de rigueur.

Though prices continue to fall, you can expect to pay about a third more for a notebook than for a desktop PC with the same CPU; you can also expect to get about a third less performance.

The most common single CPU in our roundup was the 486DX2/66, present in 19

book lines. The technically elegant active-matrix monochrome display, used by Apple and Compaq, is all but a dead end: For the same price, you can have dual-scan passive-matrix color.

Dual-scan color typically costs only \$300 to \$500 more than monochrome; active-matrix color adds another \$750 to \$1,300 to that. If you place monochrome, passive color, and active color systems side by side, you'll see clear differences in brightness, sharpness, and contrast. But dual-scan passive color is more than acceptable and allows slightly longer battery life because it uses less power. Often the choice is between a 9.5-inch dual-scan color or a more expensive 8.5-inch active

Second, notebooks do not have fast graphics accelerator chips. And third, few notebooks today have an external CPU cache, which is important for high-speed processors and essential for clock-doubled or -tripled CPUs. The addition of 512K of external cache to a DX4/75-based WinBook XP prototype doubled the notebook's CPU score to 47, the highest of any notebook we've seen.

One unpleasant performance surprise was that of the Duracom TravelPro systems, which use Cyrix's new 486DX/33 CPUs. Because Duracom apparently implemented a write-through cache instead of a write-back cache for these chips, TravelPro processor scores were closer to Intel 486SX/25 CPU scores than to 486DX/33 scores.

KEY PLAYERS

Of the 40 million computers that will be sold this year worldwide, nearly one in four will be a portable, according to market researcher InfoCorp. The trend toward consolidation among portable PC sellers continues today, and eight vendors account for more than half the U.S. sales. Four 800-pound gorillas dominate the market: Apple, Compaq, IBM, and Toshiba. Another four vendors—AST, NEC Technologies, Texas Instruments, and Zenith Data Systems—are gorillas-in-waiting. Overtaking Apple, Compaq was the biggest seller last year; IBM was the biggest market-share gainer. IBM could surpass Compaq if it catches up on its backlog of ThinkPad orders, which is rumored to be in excess of \$1 billion.

Regardless of market share, IBM's matte-black ThinkPads are the mindshare leaders—the notebooks on everyone's wish list. The new ThinkPad 755C shows off IBM's technological prowess with a 10.4-inch active-matrix color display, a DX2/50 or DX4/75 CPU, a TrackPoint II pointing stick, great battery life, acceler-



- *Full-featured notebook* **IBM ThinkPad 755C**
- *Full-featured notebook* **TI TravelMate 4000M**
- *Value-priced notebook* **WinBook XP DX2/50 4/260 Monochrome**

Of the 70 portables we reviewed, there is at least one for every possible combination of wants, needs, and budget. But from this exceptional cast of charac-

ters, three stand out and earn an Editors' Choice award: IBM's ThinkPad 755C, Texas Instruments' TravelMate 4000M, and WinBook's XP DX2/50 4/260 Monochrome.

The ThinkPad incorporates so much (including built-in audio and a 10.4-inch active-matrix screen) into so small and light a package that it is truly a marvel of miniaturization. At \$7,389, the 755C is not cheap. Priced more reasonably, the new TI TravelMate 4000M series from Texas Instruments incorporates SCSI, MIDI, and audio into one of the best designed notebooks we've seen. The lack of a 10-inch color screen option is the only area where we find fault.

The ultimate bargain of this roundup was the value-priced Win-

Book XP DX2/50 4/260 Monochrome. Priced at just \$2,098 for a monochrome DX2/50 system, the 6.5-pound notebook offers optional audio and your choice of pointing stick or trackball—or both. It also set a record by lasting more than 9.5 hours on our battery tests.

In addition, two systems were worthy of honorable mention. Ambra's DX4/100-based N100T offers near-desktop performance, and the AT&T Globalyst 200 provides a nice compromise between price and performance. Though not reviewed, Toshiba's Portégé is the best (and priciest) subnotebook we've seen. The newest T3600 model includes a 486SX2/50 CPU and a hard disk as large as 250MB; expect to see it by early summer.

ated local-bus graphics that can handle up to 30 frames of video per second, a built-in microphone and two small speakers, a removable hard disk of up to 810MB, and a docking station with a double-speed CD-ROM drive and speakers.

In what may be the ultimate incarnation of Toshiba's current full-bodied notebooks, the Toshiba T4800 series has just about everything you'd want, including a 524MB hard disk. Most of its features are similar to the ThinkPad's, except the Toshiba unit weighs almost a pound more and has an ivory case, an oversize 16.5-mm PCMCIA slot that allows direct connection of an RJ-11 phone plug (a plus),

and an external snap-on Microsoft BallPoint pointing device (a minus, because it's bulky and easily forgotten). In addition, Crypt Card, a PCMCIA-based data encryption card, protects sensitive data.

Compaq's LTE Elite series is replacing the long-in-the-tooth flagship LTE Lite line. The Elite has a unique built-in power supply, so you need carry only a power cord and no power transformer (see the sidebar "Compaq LTE Elite 4/75CX Model 340"). The Elite needs a fan to dissipate the extra heat, but that adds only an ounce or two. Expect the Elite to appear on the market by midsummer.

We were also impressed by Texas Instruments' TI TravelMate 4000M. This series is a significant step forward from the TI TravelMate 4000E and offers PCMCIA capability, sound, and what is likely the industry's best multimedia docking station. As always, TI's well designed memory subsystem provided excellent performance. Among lesser-known brands, WinBook Computer

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HIGHLIGHTS

Notebooks

NOTEBOOKS KEEP GETTING BETTER, but there has not been a quantum leap in any of the enabling technologies.

DX2/66 VS. DX4/75: A TIE. The DX2/66 has the lead in raw processing ability, but the reviewed DX4/75 churned through apps more quickly.

LARGE HARD DISKS ARE COMMON. Don't settle for a 80MB hard disk in your notebook; many manufacturers are installing 300MB (and bigger) hard disks in their products.

BATTERY TIME is up. The average system in this review of 70 notebooks lasted 3 hours 20 minutes, an hour more than in our last notebook review. The WinBook XP was the star, lasting over 9 hours.

TOMORROW'S NOTEBOOK will take a step forward in technology with a 12-inch-diagonal color screen, full-size CD-ROM drive, and more. Expect to see the first of these fully loaded systems in mid-1995, priced in excess of \$5,000.

VIDEO QUALITY STILL LAGS behind that of desktop units. Whether active- or passive-matrix, LCDs cannot display information fast enough to take advantage of today's best video chips.

THE AVERAGE NOTEBOOK is powered by a 486DX2/66 CPU, carries a 200MB hard disk, uses a dual-scan passive color screen and nickel hydride batteries, and can only muster about two-thirds the computing power of a comparable desktop PC.

Corp. caught our interest for its WinBook XP DX2/50 4/260 Monochrome. At 6.5 pounds, the WinBook XP is the lightest full-size notebook in this roundup; it also had excellent battery life (over 9 hours on our tests), optional audio, and a good price—\$2,098 for the monochrome DX2/50 version.

Back when Apple portables were overweight and underpowered, it wasn't uncommon for a Macintosh desktop user to have a PC portable. Now, the reverse is true; it's not uncommon for a PC desktop user to be toting a PowerBook. Though hobbled by the aging Motorola 68000-series processor, Apple's latest PowerBook, the 540, is upgradable to a PowerPC processor. In addition, Apple has moved from its much-admired trackball to a touch pad that allows the user to navigate through applications with the touch of a finger. A pair of speakers grace the upper corners of the screen (see the sidebar "A New Generation of Apple PowerBooks").

Much of the midrange market involves portables built by one vendor and resold by others. Digital and Dell, for instance, remarket AST portables. AT&T Global Information Systems (for-

merly NCR) currently resells NEC Versas as its Safari 3181s.

SUBNOTEBOOK MARKET

Roughly one out of every ten notebooks sold today is a subnotebook. This four-pound format involves many compromises, such as a shrunken keyboard, external floppy disk drive, small screen, and less-than-stellar performance. Toshiba's too-new-to-review T3600 Portégé, a follow-up

to its breakthrough T3400, adds an 8.5-inch active color display, DX2/50 CPU, and 250MB hard disk but can cost upwards of \$5,000. Though the new IBM ThinkPad 510, Gateway 2000 HandBook DX2-40, Zenith Z-Lite, and Epson 4000 represent more modestly

priced subnotebooks, HP and Compaq have staked out the low end of the market with their OmniBook and Aero offerings.

We see the subnotebook market as comprising two groups of buyers: a small, affluent segment of Portégé-type users (some of whom might be able to get by with no other computer) and a much larger segment of cost-conscious note-takers and e-mail communicators. A major step forward in this area occurred earlier this year when IBM announced a patent on a

folding keyboard; this might allow a system with full-size, 19-mm keys to collapse to an 8- by 10-inch footprint, rather than the more common 9- by 12-inch size.

FUTURE TRENDS

In the full-size notebook arena, expect to see continued evolution—lighter weight and faster CPUs. We polled the top notebook manufacturers and synthesized what will likely be the full-featured notebook for the middle of 1995 (see our illustration of "Tomorrow's Notebook"). In the future, you'll see a 7-pound Pentium-based system with a built-in, full-size double-speed CD-ROM drive (either removable and alternating with a floppy disk drive or placed underneath a fold-up keyboard). By contrast, Panasonic's CF-V21P, reviewed here, has an optional 3.5-inch CD-ROM drive. Because of the dearth of software available for the smaller disks, we feel that the CF-V21P is the answer to a question few buyers are asking. We believe that the next step down from the 5.25-inch CD-ROM will be a data version of the 2.5-inch Sony Minidisc.

You should also expect to see active-matrix color panels as large as 11 or 12 inches diagonal with resolutions of 800-by-600 and possibly 1,024-by-768. Smaller color displays will get cheaper as Japanese manufacturers add capacity and Korean companies enter the business. It's also possible that 1995 will introduce actively addressed passive panels that provide most of the brilliance and speed of active

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What the Numbers Mean

Faster processors don't always guarantee more processing power. Nor do they promise the ability to run Windows applications more speedily. We found that an optimized DX2/66 notebook offers performance similar to that of a DX4/75—and for less money.

WINSTONE 94

The newest notebook CPU is Intel's DX4/75, which runs faster internally and has more internal cache than the DX2/66. But in both computing power and ability to run applications, both chips perform at about the same level. The average Winstone score for the 7 tested DX4/75 units was 39.9; the average score for the 20 tested DX2/66 systems was 37.2. On our processor tests, however, the DX2/66 units edged out the DX4/75s.

On the other hand, the DX4 chip does offer better applications performance at the 100-MHz level. The two notebooks in this lineup with DX4/100 chips—the Ambra N100T and the Aquiline Hurricane DX4/100 Multimedia Notebook—posted excellent Winstone marks of 62.3 and 56.1, respectively.

Too Close to Call

While the DX2/66 processor has a slight edge in terms of processing ability, the DX4/75 can handle Windows applications a little faster. The bottom line: The two chips offer nearly equivalent performance.



PROCESSOR

The battle between the DX2/66 and DX4/75 units continued on our processor tests. The average processor score for the DX2/66s was 31.0, while the DX4/75 group averaged 29.6. Seven DX2/66 entries each achieved the top processor score of 34.7.

The DX2/66s and DX4/75 units were edged out by the top-performing DX4/100 systems. The Ambra N100T and Aquiline Hurricane DX4/100 scored 40.5 and 40.1, respectively—about average for a DX2/66-based desktop. The gap between the processing power of a notebook and that of a desktop unit with the same CPU is attributable as much to processor and memory architecture as it is to external cache.

The laggards on these tests were the three Cyrix DX/33-based Duracom units, each of which used a slower write-through cache. Pin-compatible with Intel's equivalent CPU, the Cyrix processor includes the same amount of internal cache, carries a floating-point unit, and is a 32-bit chip throughout. But the Cyrix CPU is still slower than Intel's DX/33 (which includes an FPU) and SX/33 (which doesn't

have an FPU) processors. The saving grace of the Cyrix DX/33 is that units based on it cost significantly less than comparably equipped Intel-based units.

GRAPHICS WINMARK AND DOS VIDEO

Notebooks traditionally post far lower Graphics WinMark scores than desktops, with some systems barely able to hit the 2-million-pixels-per-second mark. These lower scores stem partially from the fact that most notebooks carry slower CPUs to maximize battery life. Also, notebooks have less-sophisticated graphics chips than desktops—since even the best LCD panels do not have the responsiveness of a CRT monitor and thus do not warrant the use of a fast graphics chip.

The tested notebooks had an average Graphics WinMark score of 3.9 million pixels per second. Offering proof positive that a powerful CPU helps graphics performance were the DX4/100-based Ambra N100T and Aquiline Hurricane DX4/100, the Aquiline Hurricane DX4/75 Multimedia Notebook, and the Intelligent Executive EchoBook DX4-75. Each posted a score exceeding 7 million pixels per second.

A few of the graphics chips, too, showed more muscle than others. Western Digital's Rocket chip (the chip found in the Aquiline units) and Chips & Technologies' 65530 chip (the chip found in Ambra's entries) showed particularly impressive performance. Most of tested units performed as well or better in DOS video as would their desktop counterparts. Units with the Rocket chip performed best, with some DOS video scores topping 4,000. The best performers on our DOS video tests were the Aquiline Hurricane DX4/100, the Commax Smartbook II Active Matrix, the IBM ThinkPad 755C, and the Twinhead Slimnote 486E 4DX2/66T. The underachievers of the bunch were the pair of Compaq Contura Aeros.

DISK WINMARK

Like most desktops, some notebooks are now coming standard with Microsoft Windows for Workgroups (WfWG). In terms of look and feel, Windows and Windows for Workgroups are not that different from each other. But when it comes to disk performance, WfWG takes the lead. The fact that most of the top six Disk WinMark performers are based on DX4 or DX2/66 CPUs only partially explains their top Disk WinMark scores; another factor is the fact that they were all running Windows for Workgroups during testing. WfWG's superior 32-bit file-access option and efficient software caching means better disk performance even with less-powerful CPUs. For example, the DX/33-equipped AMS TravelPro 5333—running Windows for Workgroups—edged out the Aquiline Hurricane DX4/100—running Windows. Scores were 921 and 886, respectively.

At the bottom were the SX/25-based units. Many of these systems were outgunned by the top performers by a factor of three. Another unit that did not fare well was the DX2/50-based AT&T Globalyst 200 (DX2/50), indicating that performance is based as much on integration as it is on componentry.

DOS DISK

As a group, these notebooks offered impressive DOS disk performance. The average score was 729, and more than a third of the units scored over 800. Such performance, particularly that of the top-scoring systems (the DX4/75-based IBM ThinkPad 755C placed first overall, posting a score of 985), competes directly with that of many desktops. The reason behind such excellent performance is that drives have not just gotten smaller, they've gotten faster.

A good example of this is Toshiba's MK2428FC hard disk. It's a 540MB drive with a 512K cache and an average access time of 12 milliseconds. The average score for the nine systems with it was 866—about 15 percent faster than the group average.

But with a hard disk, the larger the data capacity the better. Although the IBM ThinkPad 755C has a 15-ms IBM drive with only a 32K cache, its capacity is 540MB. Our disk tests exercise over 30MB of disk space at a time and are extremely taxing to smaller-capacity drives. Those systems with drives of 300MB or larger averaged 200 points higher than those with drives of less than 300MB.

DOSMARK

The two notebooks with DX4/100 CPUs, the Ambra N100T and the Aquiline Hurricane DX4/100, earned the top two DOSmark results, with scores of 602 and 620, respectively. At the other extreme were the Compaq Contura Aero units, with scores of 218 and 267, respectively. Each uses a 486SXJ CPU with a 16-bit—rather than a 32-bit—interface. This chip may be a step backward in performance, but keep in mind that it is significantly less expensive than the full 32-bit version. Moreover, these units offer excellent battery life.

BATTERY LIFE

As we discovered, several notebooks are capable of achieving long battery lives while operating at maximum CPU speeds. The most remarkable example of this was the WinBook XP DX2/50 4/260 Monochrome. Equipped with a TSTN monochrome screen, the system offered good performance for its CPU class and ran for over 9 hours on our ZDigit tests. The two passive-color Compaq Contura Aeros also demonstrated impressive road skills.

Active-matrix color screens consume even more power, but the SX/33-based active-color IBM ThinkPad 360C managed its power needs effectively enough to run more than 5 hours 30 minutes. Equipped with a larger active-matrix screen, the IBM ThinkPad 755C lasted just over 5 hours.

Several notebooks equipped with 3.3-volt DX4/75 CPUs ran for over 4 hours. This group included the Ambra N75D, with an active-color screen; the Gateway 2000 ColorBook 486DX4-75, with a dual-scan passive-color screen; and the Toshiba T4800CT, with an active-matrix color screen. Several other of the DX4/75 systems, however, struggled to last just 2 hours.—*Analysis written by Tami D. Peterson*

How We Tested

In preparing this issue, we used PC Bench 8.0 to test processor, video subsystem, and disk performance using DOS applications. We also used WinBench 4.0 to obtain Graphics and Disk WinMark scores, and we used the application-based Winstone 94, Version 1.0, to determine overall system performance under Microsoft Windows 3.1.

Winstone 94, Version 1.0, measures the time a PC takes to execute a set of application scripts that exercise 12 of the most popular Microsoft Windows 3.1 applications. We normalize Winstone scores relative to a 386DX/25 Compaq Deskpro/M with 4MB of RAM, which has a Winstone score of 10. A system with a Winstone score of 20 performs twice as fast as one with a score of 10.

The **processor** score reflects CPU, RAM, and RAM cache performance. It is based on a large instruction mix and either the floating-point coprocessor test or the floating-point emulation test, depending on whether the PC has a coprocessor—which could be either integrated with the main processor or located on a separate chip.

The **Graphics WinMark** score is a measure of PC graphics performance under Microsoft Windows 3.1. We run 66 different tests to evaluate each system's handling of the Windows GDI (Graphics Device Interface). These tests are based on extensive application profiling.

The DOS-based **video** score is a weighted harmonic mean of tests that measure 8- and 16-bit VGA write operations involving both text and graphics.

The **Disk WinMark** score reflects disk subsystem performance under Microsoft Windows. The tests use different files and file operations in a blend based on extensive profiling of applications' disk usage.

The DOS-based **disk** score gauges the performance of a PC's disk subsystem, which includes the hard disk, disk controller, and any hardware or software disk caches. Our tests use more than 100 files in six directories totaling over 30MB. The operations performed include file reads, file writes, file creation, and file deletion.

The **DOSmark** score is a composite rating derived from the processor, video, and disk scores. It indicates a PC's ability to run DOS applications quickly.

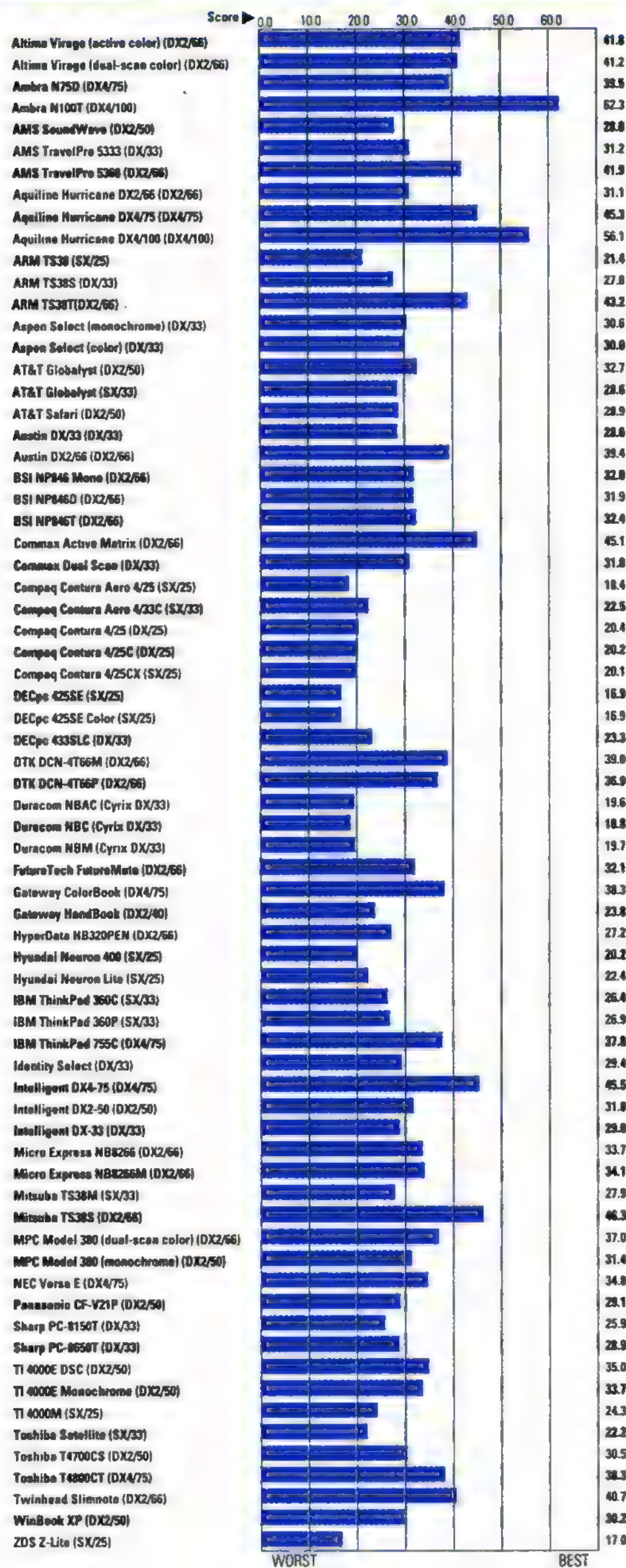
The **Battery Life** score uses ZDigit, Version 2.0, and is based on data accumulated over years of testing laptop and notebook battery lives; it provides an indicator of how long a notebook will operate between charges.

To test these notebooks, we first condition their batteries with three consecutive-use cycles of charging and discharging. Then we set each unit's power-management features for optimum performance. Hard disk timeout is set for 1 minute, displays are set for 2 minutes, and standby mode is set for 3 minutes (or the closest available setting in each case). Each unit's suspend features are disabled. The ZDigit program is set with 2 minutes of active time, 2 minutes of idle time, and 8 minutes of sleep time.

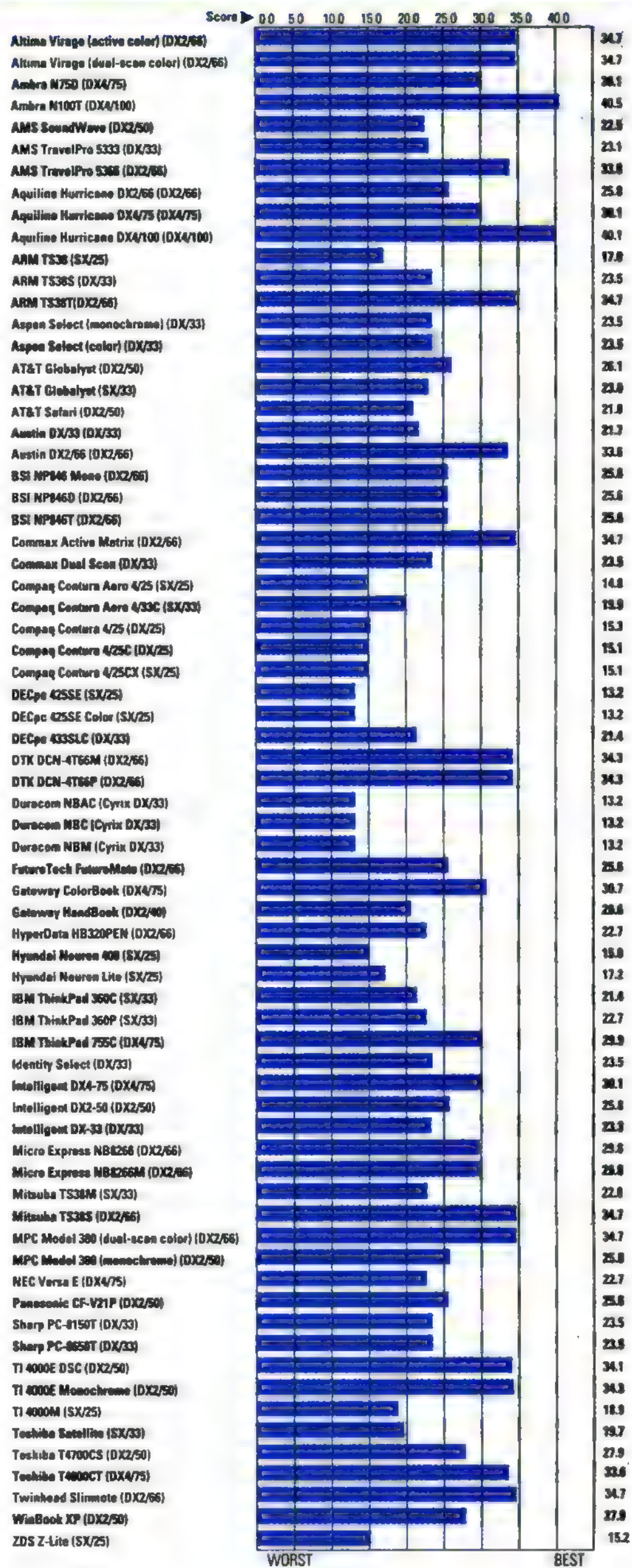
We then test each notebook in one of three ways. If a notebook has a keyboard port and is able to accept certain keystroke commands, we administer our Undigit test. The second procedure is our Boinker test, which involves a mechanical finger that physically hits keys at the same intervals used in our Undigit test. Some of the notebooks in this roundup have keyboard ports that cannot interpret Undigit's special keystrokes, and those have to be tested manually using the Mandigit protocol.

The ZDigit program lets each notebook go into its preset sleep mode after a period of inactivity. Then it brings up a Windows application and lets it run for a specified time by injecting the appropriate keystrokes. The state of the screen is constantly monitored, as is the parallel port. The cycle repeats until the battery is depleted.

WINSTONE 94



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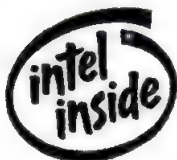
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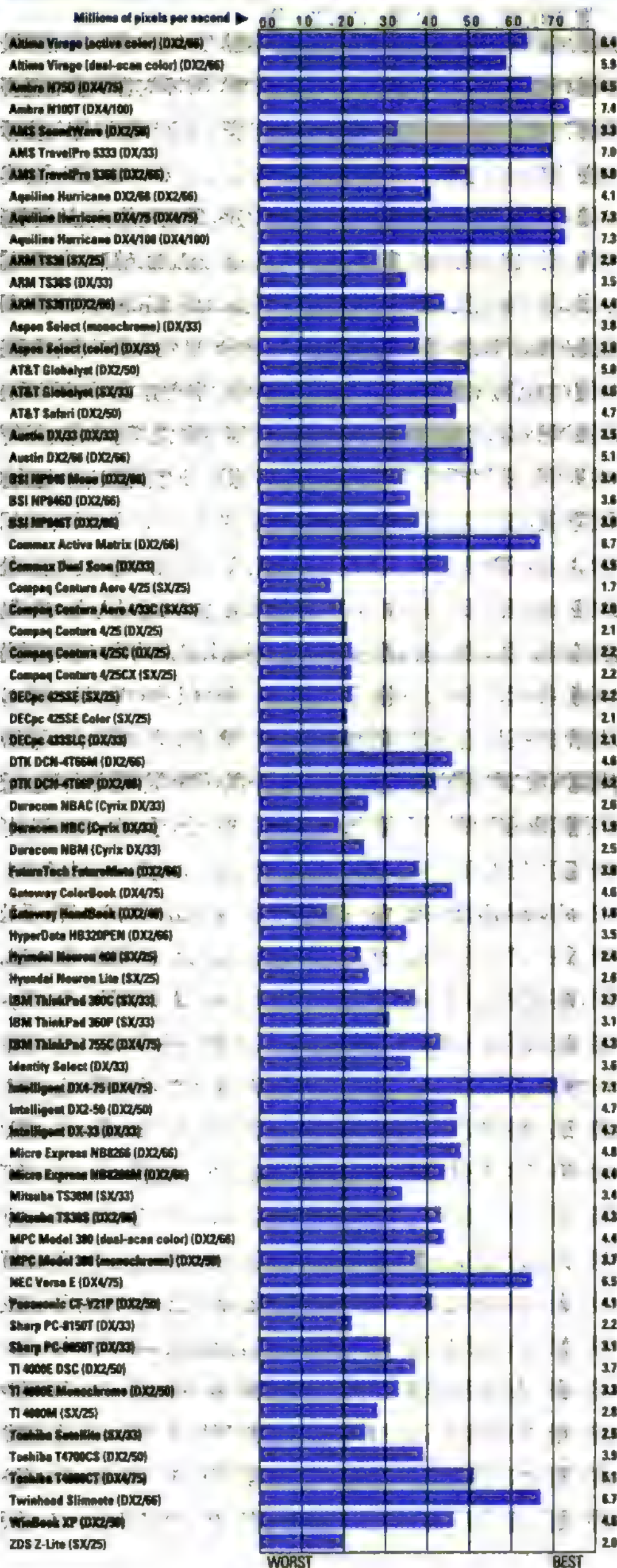
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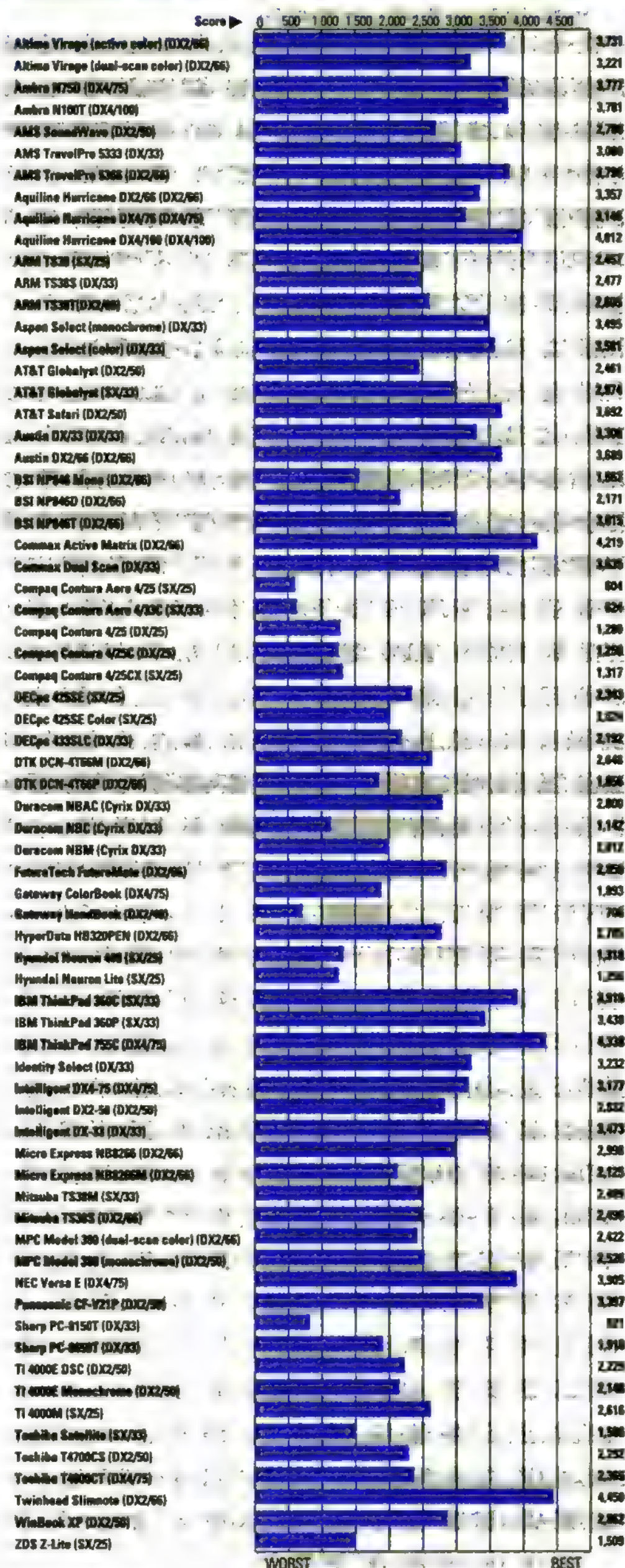


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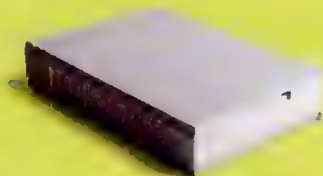
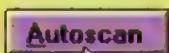
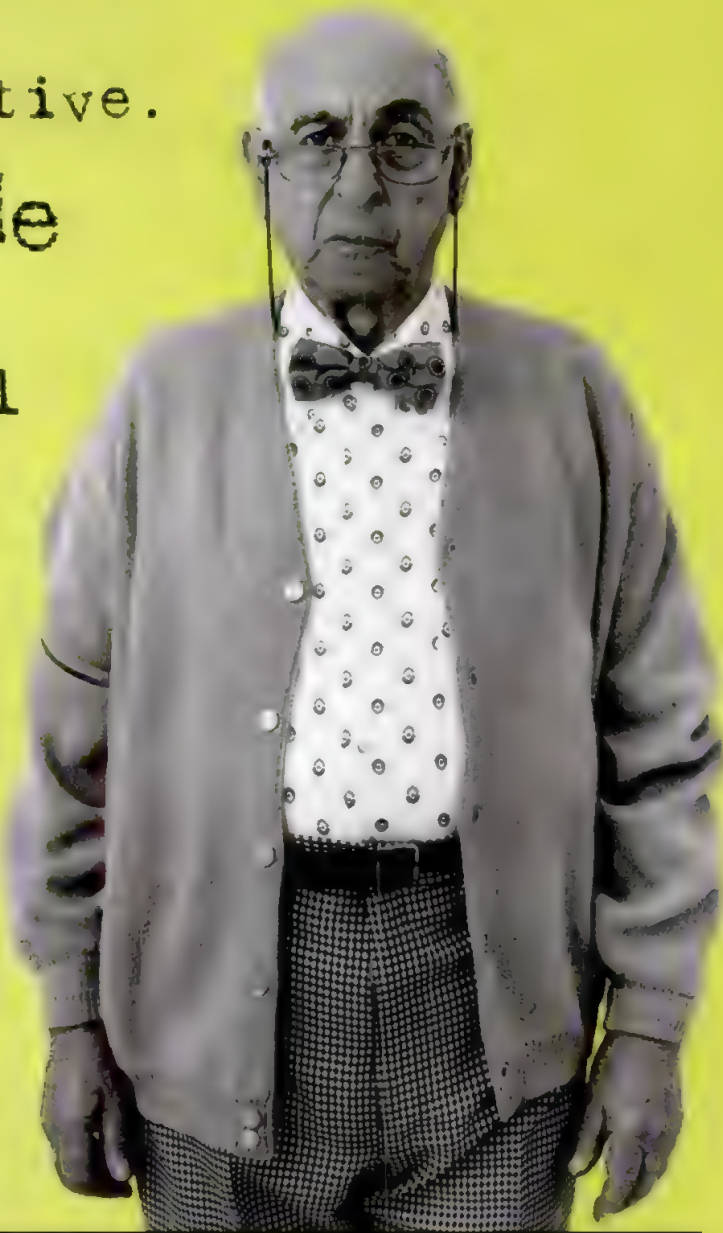
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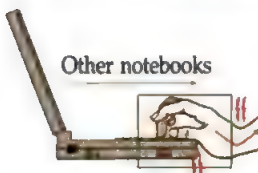


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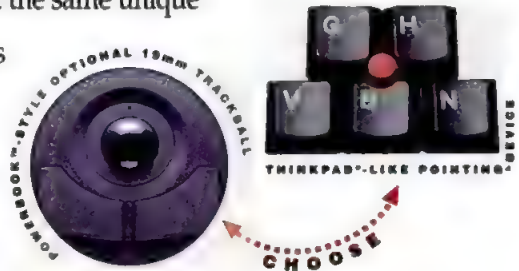


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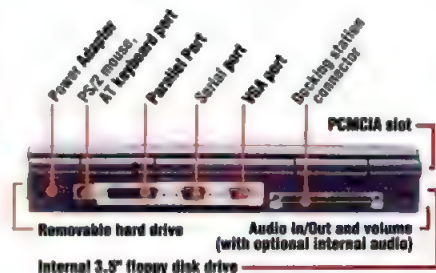
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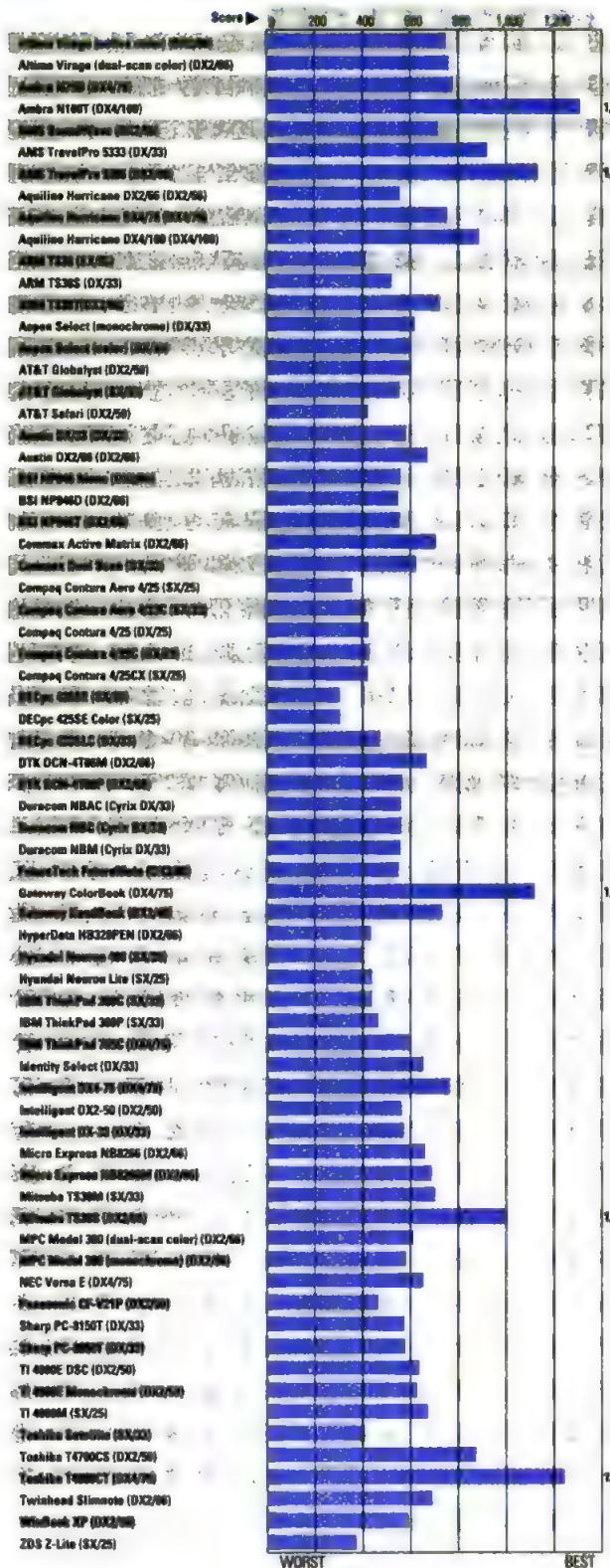
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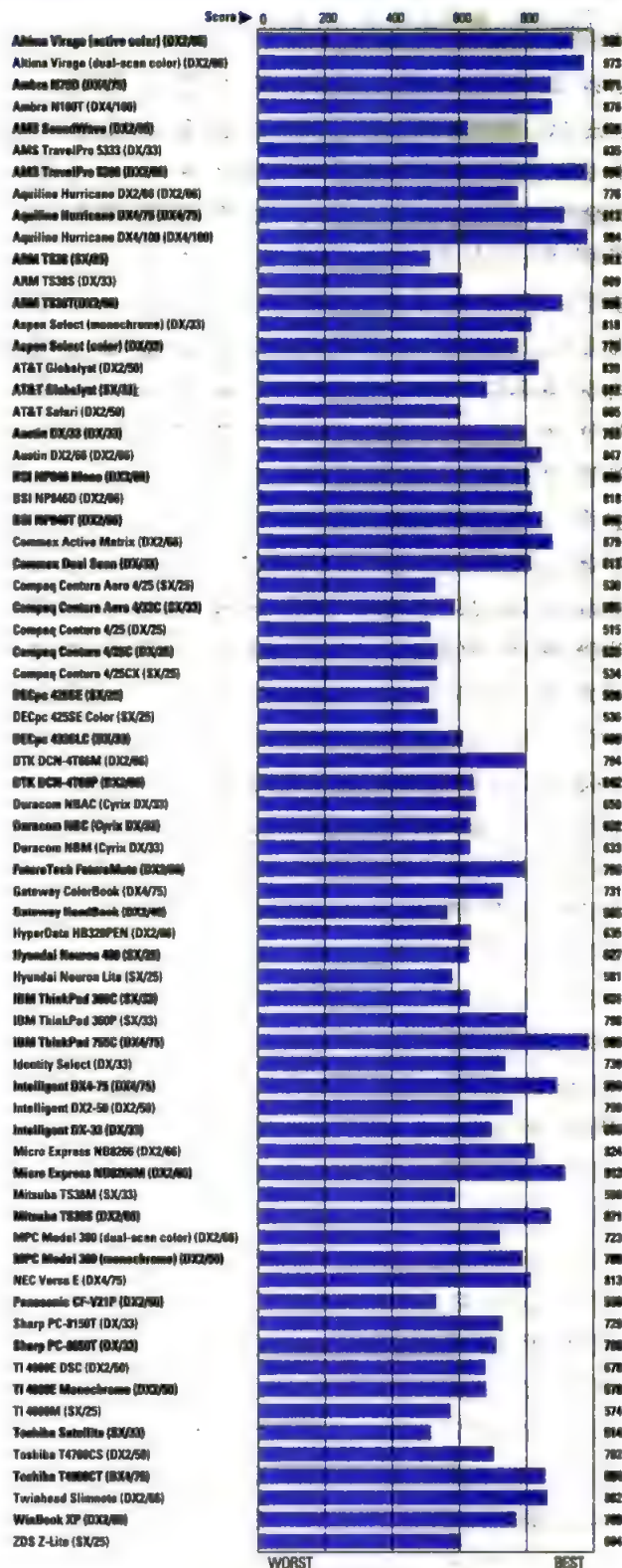
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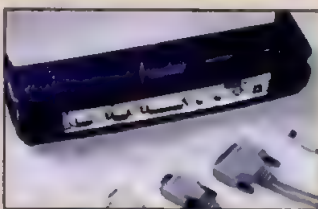
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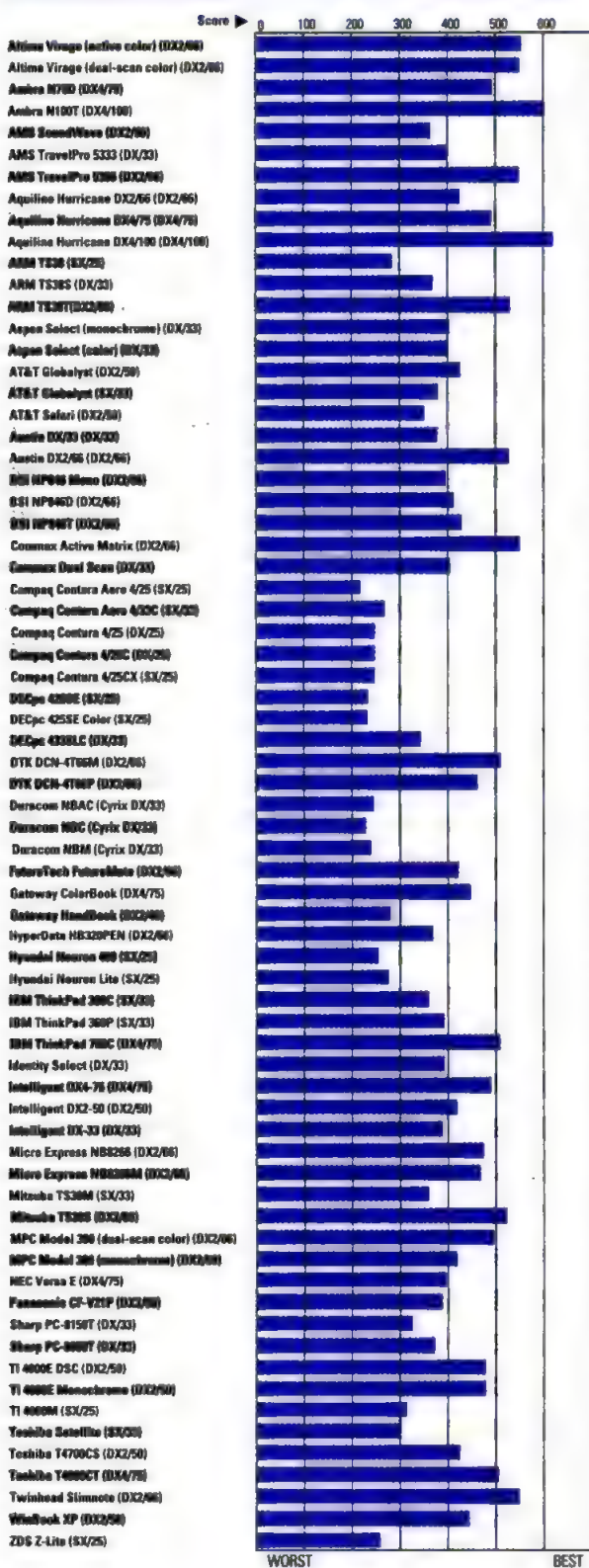
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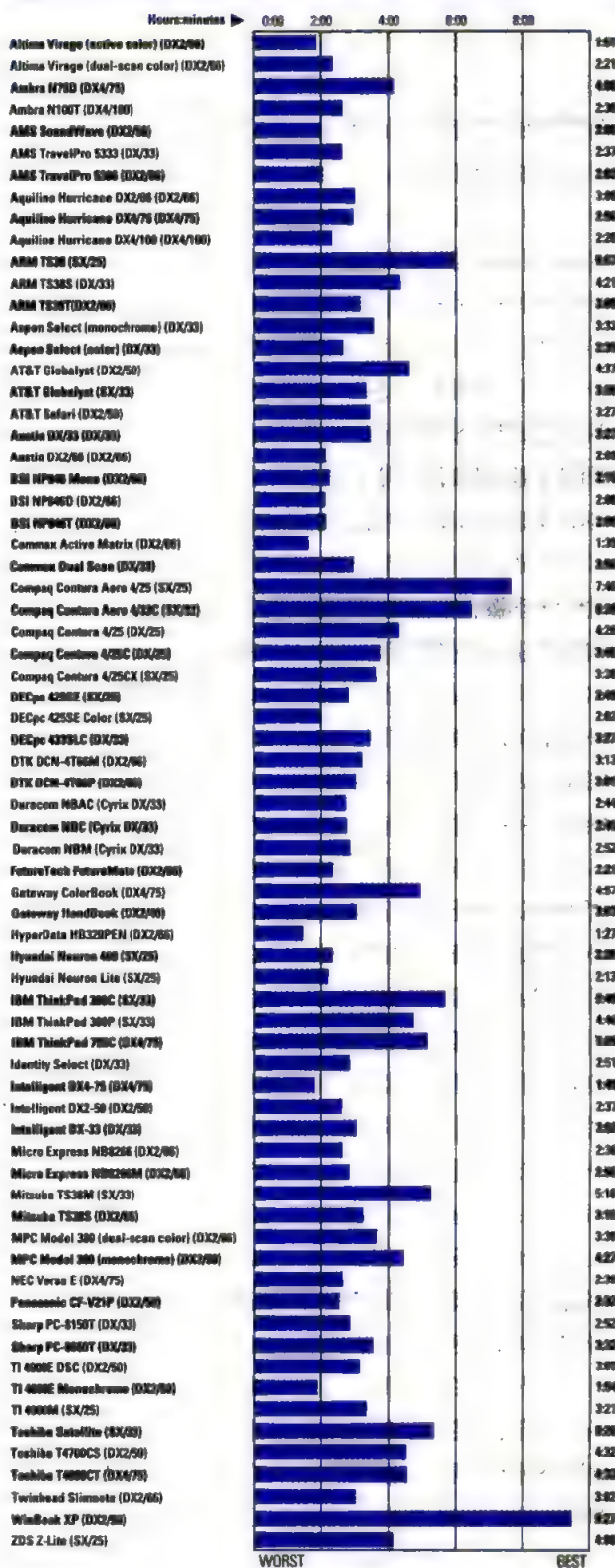


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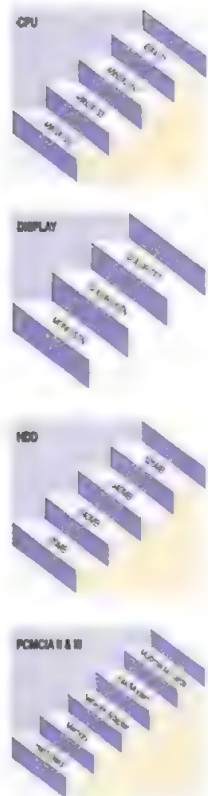
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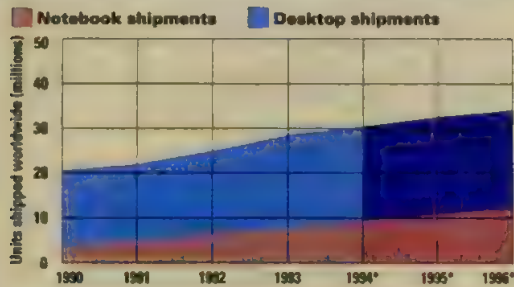


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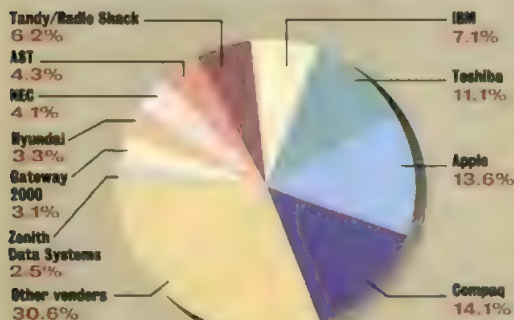
How the Notebook Market Breaks Down

Worldwide, the notebook market continues to grow faster than the desktop market.



* Projected
Source: Computer Intelligence InfoCorp

PC Vendors' Market Share (U.S. Notebook Shipments, 1993)



Source: Computer Intelligence InfoCorp

Top 5 color-system vendors

Vendor	Market share*
Compaq	16.9%
Toshiba	14.7%
NEC	9.9%
Texas Instruments	9.7%
AST	9.4%
Other vendors	39.4%

Top 5 monochrome-system vendors

Vendor	Market share*
Compaq	15.8%
Apple	14.1%
Toshiba	10.3%
IBM	9.9%
Zenith Data Systems	5.2%
Other vendors	44.7%

* Percentage of units shipped in the U.S. in 1993
Source: International Data Corporation Inc.

panels at a cost equivalent to dual-scan panels. We should also see laptop video chip sets that allow for higher refresh rates when used with external monitors. Many chip sets support 1,024-by-768 resolution only at 60 Hz, which can be rough on the eyes; accept nothing less than 70 Hz.

In future systems, some vendors will heed the complaints of PCMCIA modem users annoyed by the nonstandard, easy-to-lose connection cables and will move the modem back inside the PC where it belongs. Notebooks will probably feature V.32bis fax modems (14,400 bps) this year and V.34 fax modems (28,800 bps) next year; eventually, the modem chip set may be supplanted by a digital signal processor that will also be a sound system.

Nickel hydride will continue to be the battery of choice for all but the cheapest portables. Lithium ion technology provides substantially more power per pound than NiMH, but you may want to be sitting down the first time you hear the cost of a replacement battery: Toshiba gets about \$325 for its Portégé lithium ion battery. A few more vendors may adopt the Duracell uniform-size batteries currently

used on the Compaq Aero. If the technology catches on, you'll be able to find replacement batteries anywhere; right now, however, the chief beneficiary of this technology is Duracell.

REVIEW CRITERIA

To be included in this review, vendors had to provide a 486-based notebook with a travel weight (including the system, battery, transformer, and clip-on pointing device, if any) of no more than 9 pounds. Each system had to have at least 8MB of system memory and a 120MB hard disk, a modem, and DOS and Windows preinstalled. That filter still netted us more than six dozen systems. Of those, the Ergo could not supply working DRAM for its SubBrick, and Midwest Micro's unit had hard disk problems. Reviews of the remaining 70 systems are arranged alphabetically by vendor name. Multiple systems submitted by the same vendor were tested separately, and the results were compiled into a single review. This procedure was also followed in cases where several vendors sell substantially the same machine; for instance, systems from

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CIRCLE 052 ON READER SERVICE CARD

Suitability to Task: Notebook PCs

The **DOS applications** score reflects a system's ability to run DOS software. *Excellent* systems are those that earned top PC Bench 8.0 DOSmark scores and can run TSRs and memory-intensive applications. The DOSmark score takes into account processor, hard disk, and video performance.

Windows applications is a more demanding category and indicates how well a system operates Windows software. Factors include Graphics WinMark, Disk WinMark, and Winstone 94 test scores as well as the system's hard disk options and its diagonal screen size.

The **road warrior** rating indicates how adequately a traveling companion a portable is. *Excellent* units are compact, light, have a long battery life, and include a large screen, a built-in pointing device and PCMCIA slots

The **desktop replacement** rating is important

if the portable will be your sole computer both at home and on the road. Here, fast performance is more critical than light weight or a long battery life. Optional docking stations or port replicators are a plus in this category.

SERVICE AND RELIABILITY

In our 1994 Service and Reliability Survey, we sent questionnaires to 17,000 randomly selected PC

Magazine subscribers; about half responded. Results are only given for vendors for which we received an adequate number of responses. Vendors are rated *above average*, *average*, or *below average* in three categories

Reliability scores indicate whether PC owners felt their systems met their expectations for consistent operation.

Repair service results are culled from users who contacted the manufacturers to have their PCs repaired.

Technical support scores indicate how well technical-support services met respondents' expectations.

SUITABILITY TO TASK

DOS applications **POOR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **EXCELLENT**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **AVERAGE**

Technical support **ABOVE AVERAGE**

Ambra, ARM, MPC, and Mitsuba are covered in one review under Ambra.

Some of the more intriguing systems that shipped just after our deadline are covered in a separate sidebar, "Coming Attractions." Other systems that were announced but not shipping as of our testing deadline include AST's Acentia 900, Dell's second-generation Latitude, and two subnotebooks: NEC Technologies' Versa S and the IBM ThinkPad 510. The most interesting of these are reviewed in the First Looks section of this issue.

As in the past, we rate some of the best and worst features of the portables we reviewed ("Picks and Pans") and look at the variety of mouse substitutes for the road ("Point of View"). At the end of the story is a road-warrior's guide with useful travel tips: phone numbers of on-line services, log-on information, and electrical information for major countries.

We also review remote-control software, docking stations, and multimedia add-ons for notebooks, such as portable CD-ROM drives, sound devices, and portable speakers. This is because more and more, notebooks do not stand alone but are connected to devices that bring more of the desktop to the traveling PC user.

Altima Systems Inc.

- **Altima Virage (active color)**
- **Altima Virage (dual-scan color)**

Aspen Computer Inc.

- **Aspen Select (monochrome)**
- **Aspen Select (color)**

Commax Technologies Inc.

- **Commax Smartbook II Active Matrix**
- **Commax Smartbook II Dual Scan**

Identity Systems Technology

- **Identity Select Series (DX/33)**

These seven notebook systems from four different vendors are all made by Featron Technologies Corp. of Taiwan

and differ mainly in processor and display selections. Four of them use 486DX/33 processors: the \$2,730 Aspen Select (monochrome), \$4,655 Aspen Select (color), \$2,695 Commax Smartbook II Dual Scan, and the \$3,499 Identity Select Series (DX/33). Three use 486DX2/66 processors: the \$5,055 Altima Virage (active color), \$3,718 Altima Virage (dual-scan color), and the \$4,438 Commax Smartbook II Active Matrix.

These are basic systems that lack some of the more elegant design touches gracing other notebooks we've seen. For the most part, they offer the performance one would expect from each processor level but lack the intricate level of flexibility and ergonomic design



▶ FACT FILE

Altima Virage (active color)

List price (tested configuration): \$5,055 **Configuration:** Intel 486DX2/66, 8MB RAM, Quantum 256MB IDE hard disk with 128K cache, 1 44MB floppy disk drive, 14,400-bps

PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM upgrade, \$279; docking station, \$599; nickel hydride battery, \$179

SUITABILITY TO TASK

DOS applications **EXCELLENT**

Windows applications **GOOD**

Desktop replacement **GOOD**

Road warrior **POOR**

Altima Virage (dual-scan color)

List price (tested configuration): \$3,718 **Configuration:** Intel 486DX2/66, 8MB RAM, Quantum 256MB IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM upgrade, \$279; docking station, \$599; nickel hydride battery, \$179.

SUITABILITY TO TASK

DOS applications **EXCELLENT**

Windows applications **GOOD**

Desktop replacement **GOOD**

Road warrior **FAIR**

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fax, 510-356-2408

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PC MAGAZINE EDITORS' CHOICE, APRIL 12, 1994

“is our top choice”

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“a standout in speed and value”

PC/COMPUTING BEST, MAY 1994

“is the fastest system we've ever tested”

PC WORLD BEST BUY, JUNE 1994

“stands out from the rest”

WINDOWS SOURCES EXPERTS' PICK, JUNE 1994

'Pick, Best Buy, Top Choice PC Now!

PROCESSORS	PACKAGE 1	PACKAGE 2	PACKAGE 3	PACKAGE 4
486SX-33	\$1495 Lease \$63/mo.	\$1845 Lease \$67/mo.	\$2245 Lease \$81/mo.	\$2795 Lease \$101/mo.
486DX-33	\$1645 Lease \$60/mo.	\$1995 Lease \$72/mo.	\$2395 Lease \$87/mo.	\$2945 Lease \$107/mo.
486DX2-66	\$1745 Lease \$63/mo.	\$2095 Lease \$76/mo.	\$2495 Lease \$90/mo.	\$3045 Lease \$100/mo.
DX4-100	\$1995 Lease \$72/mo.	\$2345 Lease \$85/mo.	\$2745 Lease \$99/mo.	\$3295 Lease \$108/mo.
PENTIUM-66	\$2195 Lease \$79/mo.	\$2545 Lease \$92/mo.	\$2945 Lease \$107/mo.	\$3495 Lease \$115/mo.
PENTIUM-90	\$2395 Lease \$87/mo.	\$2745 Lease \$99/mo.	\$3145 Lease \$104/mo.	\$3695 Lease \$122/mo.
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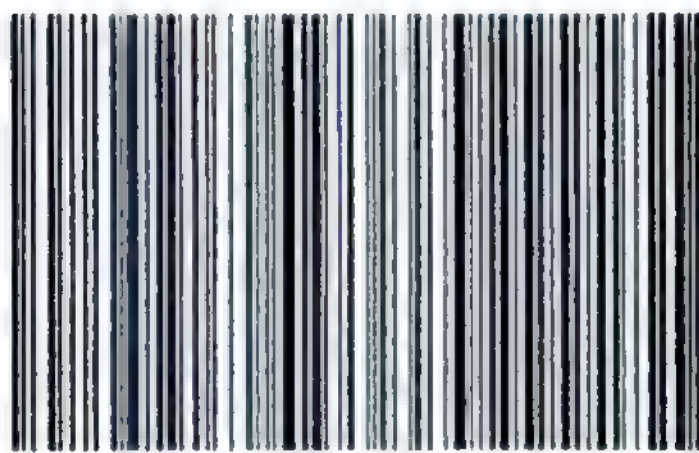
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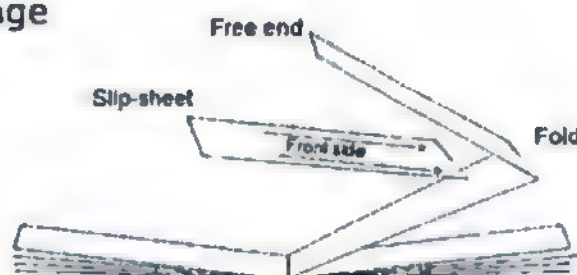


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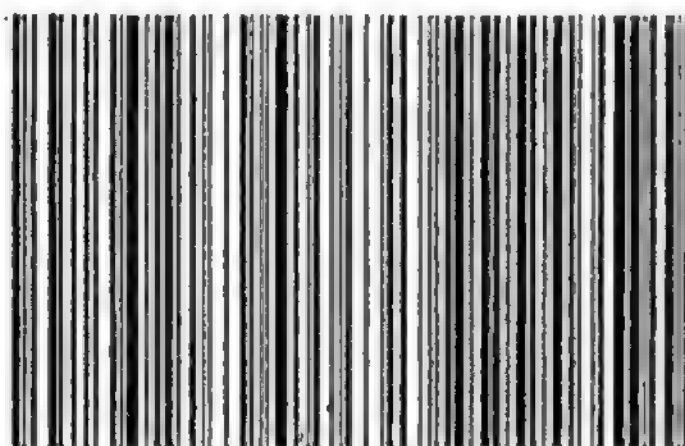
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3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

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Back

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Numerous companies offer Pentium processor-based systems. So what makes the ZEOS system the consistent winner—review after review?

The ZEOS Panthera is a completely original design—from start to finish. Many competitors use the same cookie-cutter motherboard, drop in a few service parts, add their name, and then claim to have a good computer.

Not at ZEOS. We start with a ZEOS designed motherboard, one

that is created specifically to take full advantage of the latest technological advancements employed in each system. The Panthera motherboard is stocked with exceptional features

such as a hot new ZEOS designed, on-board PCI Local Bus IDE Controller that, as *PC Magazine* said, “pushes disk access into new territory.” The PCI Controller allows up to four IDE devices to be connected directly to the system’s PCI bus, enabling you to experience faster performance and greater flexibility.

For further performance breakthroughs we’ve included a new 64-bit PCI video controller for super-fast Windows-acceleration.

The Panthera’s performance puts it far ahead of others. In fact, the performance and price are so awesome, *PC World* gave it their “number one Best Buy.” They reported: “At the top is the new ZEOS Panthera 66, a Pentium-66 that recorded the fastest benchmark results ever to come out of the PC World Test Center.”

The ZEOS Panthera received the highest scores in all benchmark tests run by *Windows Sources*: “Finding a more powerful machine than the Panthera at a better price is virtually an Aegean task.”

FLEXIBLE OPTIONS

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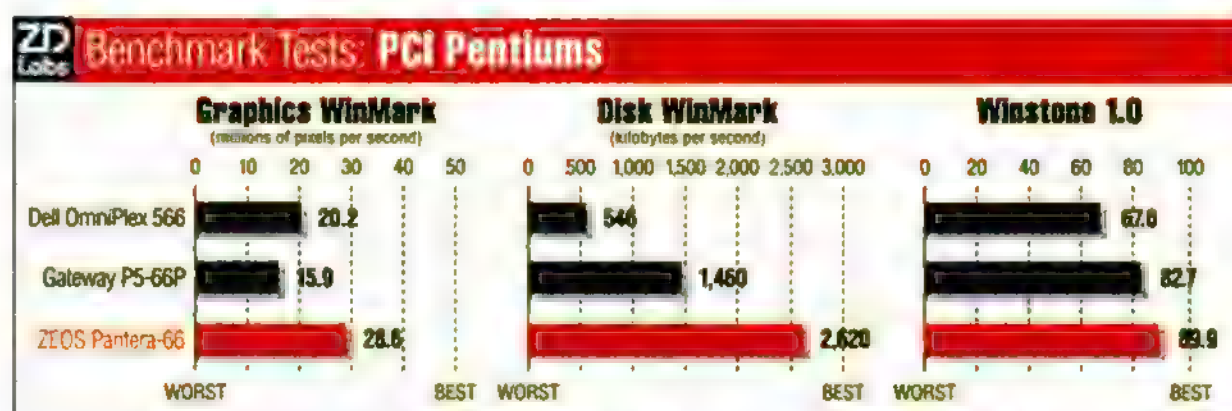
Pentium. What’s more, our Panthera DX4-100 *just* earned *PC Magazine*’s Editors’ Choice award (June 28, 1994).

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Reprinted from *Windows Sources*, June 1994

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PACKAGE #1:

- 4MB RAM, 128K SRAM cache
- 214MB hard drive, 32K cache
- 3.5" 144MB floppy drive
- VESA local bus SVGA color video
- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse



Pantera
486DX-33
\$1995
486DX2-66
\$2095

PACKAGE #2:

- 8MB RAM
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 144MB floppy drive
- PCI local bus SVGA video
- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse



Pantera
486DX2-66
\$2545

TOP GUN:

- 8MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 144MB floppy drive
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 15" SVGA color monitor
- 14,400 bps V.32 bis send/receive fax modem
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application



PC
Pantera
DX4-100
\$2895

EDITORS' 100:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 144MB floppy drive
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 14" SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application



PC
Pantera
Pentium-66
\$3195
Pentium-90
\$3395

EDITORS' CHOICE:

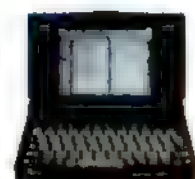
- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 144MB floppy drive
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 15" SVGA color monitor
- 10-bay vertical case
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application



BEST Windows
Pantera
Pentium-66
\$3743
Pentium-90
\$3943

BEST MM:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 144MB floppy drive
- 16-bit sound card, stereo speakers
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 17" SVGA color monitor
- 10-bay vertical case
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application



Contenda
486SL-25
\$1744

PACKAGE #2 PLUS:

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" 144MB floppy disk drive
- Internal fax modem
- DOS, Windows for Workgroups
- Lotus Organizer
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486SL-33
\$2395

PACKAGE #3:

- 8MB RAM
- 260MB IDE hard drive
- Internal 96/24 send/receive fax modem
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"At the top is the new ZEOS Pantera-66, a Pentium-66 that recorded the fastest benchmark results ever to come out of the PC World Test Center."

PC World, Best Buy, June 1994

"ZEOS Pantera-66 combines quality features, good price, and high performance..."

PC Magazine, Editors' Choice, April 12, 1994

"We suggest you spend your money on this machine—it offers the best value of any system we tested...this is a deal you simply can't pass up."

PC/Computing, BEST, May 1994

"...one system stands out from the rest: the ZEOS Pantera."

Windows Sources, Experts' Pick, June 1994

"The ZEOS (DX4) offers top performance at a good price."

PC Magazine, Editors' Choice, June 28, 1994

How can you miss when so many experts agree? The ZEOS Pantera is the top choice. Make it your choice. Call a ZEOS Systems Consultant today.



**PC MAGAZINE
EDITORS' CHOICE**

June 28, 1994

DX4-100 \$2895

- Intel 100MHz DX4 processor
- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive with built-in 256K cache
- 2X CD-ROM drive, 3.5" 1.44MB floppy disk drive
- Diamond Stealth 64/PCI local bus SVGA color graphics card with 2MB VRAM
- ZEOS 14" 1024 x 768 NI SVGA color monitor, .28mm dot pitch
- 2 serial ports, 1 enhanced parallel port
- 3 PCI slots, 5 ISA slots
- On-board SCSI socket



**PC MAGAZINE
EDITORS' CHOICE,
PC WORLD BEST
BUY & COMPUTER
SHOPPER'S "TOP CHOICE"**

April 12, 1994

June 1994

PENTIUM-60 \$3145

PENTIUM-66 \$3195

PENTIUM-90 \$3395

- Intel 60MHz, 66MHz or 90MHz Pentium processor
- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 1.44MB floppy disk drive
- Diamond Stealth 64/PCI local bus SVGA color graphics card with 2MB VRAM
- ZEOS 15" 1024 x 768 NI SVGA color monitor, .28mm dot pitch
- 2 high-speed (16550) serial ports, 1 enhanced parallel port
- 3 PCI slots, 5 ISA slots

- Flash BIOS
- 6-bay desktop case with two cooling fans
- 101-key space-saving keyboard
- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse, choice of Lotus application



PC WORLD BEST BUY

486DX2-66 \$2545

PC at left modified to include:

- Intel 66MHz 486DX2 processor
- 8MB RAM, 256K SRAM cache
- ZEOS 15" 1024 x 768 NI SVGA color monitor, .28mm dot pitch
- 14,400 bps V.32 bis send/receive fax/modem



**PC MAGAZINE
EDITORS' CHOICE,
PC WORLD BEST
BUY & COMPUTER
SHOPPER'S "TOP CHOICE"**

April 12, 1994

June 1994

- Integrated business audio
- On-board SCSI socket
- Flash BIOS
- 10-bay vertical case with two cooling fans
- 101-key space-saving keyboard
- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse, choice of Lotus application



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PENTIUM-60. \$3693

PENTIUM-66. \$3743

PENTIUM-90. \$3943

PC at left modified to include:

- 16-bit sound card
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that is found in other notebooks in this roundup.

For example, upgrading system memory is medieval and not documented in the manual. The process involves the removal of two screws and an integral piece of plastic, which, if broken, would destroy any aesthetic aspirations these systems may have had.

The design of the system includes all the basics: an integrated trackball, two Type II or one type III PCMCIA slot, and an expansion slot for an optional docking station. There are a few surprises as well, including an 8-bit sound chip, a built-in speaker and microphone, and a removable floppy disk drive that allows the addition of a second battery.

On the left hand side of the system is a



► FACT FILE

Aspen Select (monochrome)

List price (tested configuration): \$2,730 **Configuration:** Intel 486DX/33 SL, 8MB RAM, Toshiba 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400 bps PCMCIA fax

modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, \$195; 16MB RAM upgrade, \$795; docking station, \$550; Ethernet adapter, \$125

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

Aspen Select (color)

List price (tested configuration): \$4,655 **Configuration:** Intel 486DX/33 SL, 8MB RAM, Toshiba 524MB IDE hard disk, 1.44MB floppy drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Windows 3.1 **Options:** 4MB RAM upgrade, \$195; 16MB RAM upgrade, \$795; docking station, \$550; Ethernet adapter, \$125

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

Aspen Computer Inc., P.O. Box 346, 5550 Main St., Buffalo, NY 14231-0348, 800-472-3273, 716-626-0315, fax, 716-626-1541

542 on reader service card

■ Compaq LTE Elite 4/75CX Model 340

By incorporating the power adapter into the system case, Compaq engineers have performed a disappearing act to produce a system with an enviable travel weight of just under 7 pounds and one less piece to lose, break, or forget. Not only is the bulky power brick gone, but the Elite uses a standard power cord available at any hardware store. The downside of integrating the adapter is the greater thermal stress on the system, which needs a fan to stay cool.

The choice of processors and screen types shows Compaq's high-end emphasis: CPU choices include DX2/40, DX2/50, DX4/75, and eventually DX4/100 chips; screen options include 8.4- or 9.5-inch active color, 9.5-inch dual-scan passive color, or Compaq's unique 9.5-inch active monochrome UltraView screen. Hard disks go as high as 510MB.



Performance for the prototype fell roughly in line with other DX4/75 systems in this roundup.

The Elite stumbles, though, in one key area: It lacks built-in audio. Those who contemplate multimedia will

have to use a PCMCIA sound card or purchase the \$1,499 OptiByte Media Station (made by Accu-Mem Systems), which includes a double-speed CD-ROM, 16-bit sound, and

stereo speakers—making the Elite the PC world's boom box.

The Elite line starts at \$3,299 for a minimal passive color system and rises to as much as \$6,499.—*Brian Nadel*

► **Compaq LTE Elite 4/75CX Model 340.** List price: \$5,999 (estimated). Compaq Computer Corp., 20555 S.H. 249, Houston, TX 77070; 800-345-1518, 713-378-8820; fax, 713-378-1442.

Circle 480 on reader service card

panel that is available for some unknown future expansion possibilities. Of the four vendors represented here, Altima Systems has gone to the most trouble to personalize its unit, embossing the system and company names on the case in a "jeweled" logo.

Battery life is where these systems fail to meet today's standards. All the systems were equipped with a nickel hydride battery, yet the Aspen Select (monochrome) was the only system to break the 3-hour mark, at 3 hours 39 minutes; the two 33-MHz passive color systems from Commax and Identity came close, with times of 2 hours 58 minutes and 2 hours 51 minutes, respectively.

The other Aspen unit (with dual-scan passive color) posted the disappointing time of 2 hours 39 minutes. The active-matrix version of the Altima system failed to break the two-hour mark at 1 hour 51 minutes, and the passive color version posted a time of 2 hours 21 minutes.

All of these systems were consistently competitive on our benchmark tests, with average to above-average scores in their respective processor classes. The three 66-MHz units from Altima and Commax were among the elite of their processor group on all our tests.

Using a Western Digital video chip set and outfitted with 16MB of system memory, the Commax Smartbook II Active Matrix tied the Twinhead unit for the best Graphics WinMark score among 486DX2/66-based notebooks. All three 66-MHz systems had above-average Winstone and Disk WinMark scores. Among 486DX2/66-based units, the Altima Virage (active color) turned in the best DOSmark score, followed by the Altima Virage (dual-scan color) and the Commax Smartbook II Active Matrix. Their processor scores were identical, and their DOS Video scores were above average.

The Altima systems used a 256MB

Tomorrow's Notebook: Features Expected in the Coming Months

Large active-matrix screen

Expect to see active-matrix color screens that measure between 11 and 12 inches diagonally and are capable of 1,024-by-768 resolution.

Status screen

A small LCD status screen that shows battery level and active devices will be standard.

Stereo sound with speakers

Pop up stereo speakers with a pair of microphones are just the start for a system that includes 16-bit stereo built in.

Smart battery

1995 will be the year of the smart battery. By monitoring current flow, it will be better able to gauge how much runtime is left.

Fax modem

To push communications into the next generation, future systems will include internal fax modems with built-in RJ-11 phone jacks or side-swipe PCMCIA modems.

CD-ROM

A low-profile double speed CD-ROM will be exchangeable for a 3.5-inch floppy disk drive.



Touch-sensitive pad

The third-generation mouse substitute will be the touch-sensitive nonmechanical pad. Press to move the cursor; tap to activate.

Built-in power adapter

The power adapter will disappear by being either integrated into the system or relegated to an external adapter that is a slightly oversize plug.

Built-in networking

To facilitate network connections, the system will offer Ethernet and Token-Ring networking chips built in.

Full size keyboard

Full featured notebooks will continue to use desktop-size keyboards. 19 mm keys are the norm.

More PCMCIA

New designs will allow for a pair of side-by-side PCMCIA sockets that can each hold a pair of Type II devices or a Type III device.

100-MHz Pentium CPU

With the advent of high-speed 3.3-volt Pentium designs, the 100-MHz Pentium with 256K of external cache will dominate the high-end notebook arena.

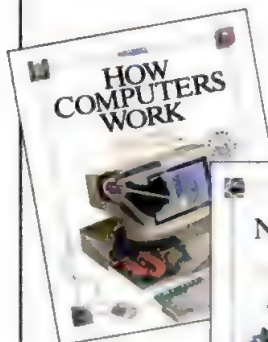
SCSI hard disk

The 1GB SCSI hard disk driven off of an integrated SCSI host will be commonplace in the high performance notebook market. Those that are removable aid in servicing.

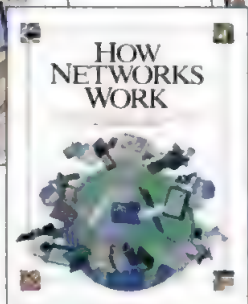
Infrared file transfer

Notebooks will include SIR/IRDA infrared sensors to print files or transfer files to desktop PCs—all without wires.

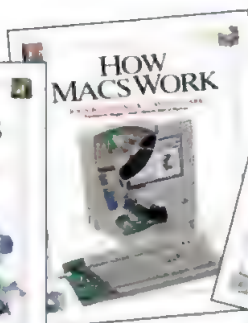
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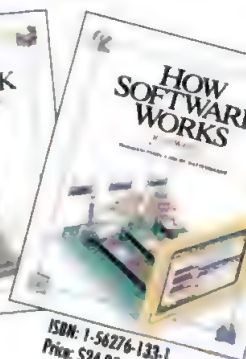
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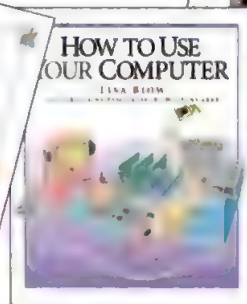
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■ Price/Performance Index: *Notebooks*

It's no surprise that each of the units with the most bang—the Ambra N100T, Aquiline Hurricane DX4/100 Multimedia Notebook, and Intelligent Executive EchoBook DX4/75—is powered by a DX4/75 or DX4/100 chip, carries lots of RAM and a spacious hard disk, and features an active color display. This power, however, doesn't come cheap: None of the top performers are priced at under \$4,900.

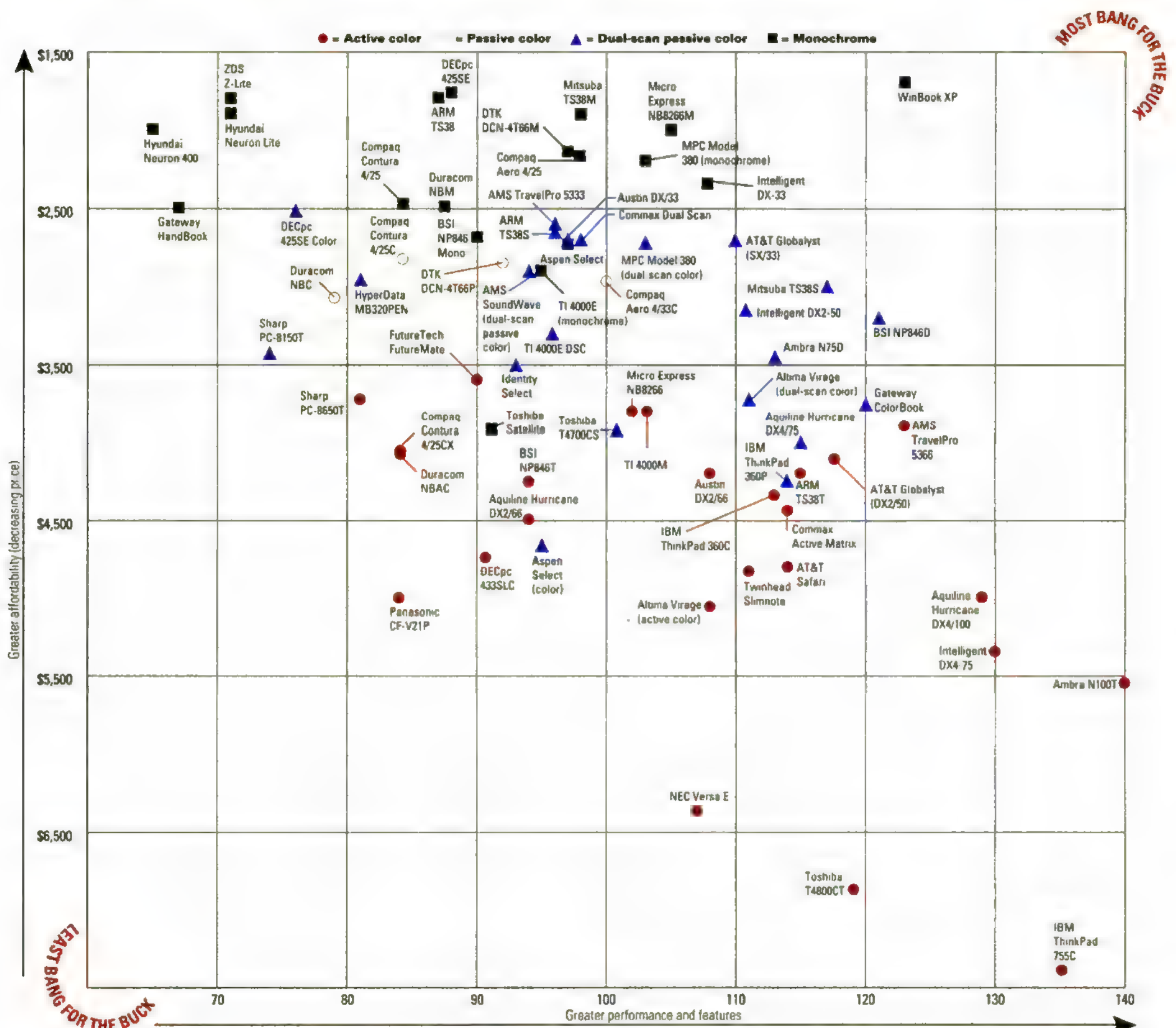
The \$7,389 DX4/75-based IBM

ThinkPad 755C is big on both bang and buck. The \$2,098 WinBook XP DX2/50 4/260 Monochrome didn't do incredibly well on our tests, but its battery lasted for over 9 hours. And the \$3,895 AMS TravelPro 5366 (486DX2/66) tied the WinBook XP on the bang scale, posting a Disk WinMark score on a par with those of 100-MHz machines.

The two Hyundai units, and the Gateway 2000 HandBook 486DX2-40, offer the least bang for the buck.

THE DATA POINTS

Benchmark test scores accounted for 50 percent of each system's performance/features score. The Battery Life score accounted for 10 percent, the travel weight for 5 percent. Features such as warranty and expandability accounted for the remaining 35 percent. For more information, look in the Hardware Library of the Editorial Forum on PC MagNet under 14BANG.XLS.

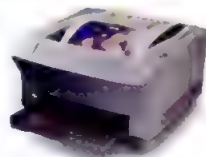




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Quantum hard disk that helped them post better scores than the Commax, which had a 340MB Toshiba hard disk; all three systems' DOS disk scores, however, were above average.

Among the 33-MHz systems in this review, the Commax entry had the best scores overall. Disk WinMark scores for the 33-MHz systems were competitive in their processor class but nowhere near that of the group's top performer, the AMS TravelPro 5333.

All four systems used a Western Digital video chip set and posted above-average Graphics WinMark and DOS video scores. Their Winstone scores were also above average, though the Identity Select Series (DX/33) system lagged slightly behind. As with the DX2/66-



► FACT FILE

Commax Smartbook II Active Matrix

List price (tested configuration): \$4,438 **Configuration:** Intel 486DX/66, 16MB RAM, Toshiba 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Desktop replacement	EXCELLENT
Road warrior	POOR

Commax Smartbook II Dual Scan

List price (tested configuration): \$2,695 **Configuration:** Intel 486DX/33, 8MB RAM, Conner 252MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 8MB RAM upgrade, \$480, 16MB RAM upgrade, \$1,660, 340MB hard disk, \$125, docking station, \$480.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Commax Technologies Inc., 2031 Concourse Dr., San Jose, CA 95131, 800-526-6629, 408-435-5000, fax, 408-435-5005
543 on reader service card



► FACT FILE

Identity Select Series (DX/33)

List price (tested configuration): \$3,499 **Configuration:** Intel 486DX/33, 8MB RAM, Toshiba 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400-/9,600-bps PCMCIA data/fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 8MB RAM upgrade, \$755; 24MB RAM upgrade, \$1,725, docking station, \$497.27

Identity Systems Technology, 1235 West Trinity Mills Rd., Carrollton, TX 75006; 800-723-8258, 214-323-4600; fax, 214-323-0666.

544 on reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

based units, the 33-MHz systems had identical processor scores and closely grouped DOSmark scores.

These systems are not as flexible or as ergonomically designed as others in this roundup. And though the Commax and Aspen entries are consistent performers, they are also relatively expensive. In short, there are systems in this review that are designed better and offer competitive performance at more reasonable prices.

—William P. Flanagan

AMS Inc.

• AMS SoundWave

The \$2,895 AMS SoundWave doesn't fit easily into categories. At 6 pounds 8 ounces, it is too heavy to be a subnotebook, but since it uses an external floppy disk drive, it isn't a true notebook, either. Many of the system's features fall somewhere between those found in full-featured notebooks and those found in value-priced notebooks. These include a DX2/50 CPU, a dual-scan color display, and 16-bit integrated audio. Unfortunately, the unit's poor performance on our benchmark tests and relatively short

battery life cast some doubt on its overall usefulness.

The design is well thought out and includes a built-in trackball that is centered under the keyboard. There is also a Type III PCMCIA slot that can accommodate a pair of Type II devices. The hard disk is removable, and the display is user upgradable. AMS also offers an optional multimedia docking station and plenty of upgradability options.

In a pinch, you can use standard AA batteries to power the SoundWave, but you may find yourself doing so rather frequently because of the system's poor battery life; it posted a Battery Life score of just 2 hours.

Benchmark test scores were just as unimpressive. Using a Western Digital video chip set, the SoundWave tied for last place on our Graphics WinMark tests in its CPU category. But it posted an above-average score overall in DOS video. The Winstone result was the lowest in the unit's CPU group, and the system's DOSmark, processor, and disk results were among the lowest in the group as well. The one bright spot was the Disk WinMark score, which was among the best of the tested DX2/50s.—WPF



► FACT FILE

AMS SoundWave

List price (tested configuration): \$2,895 **Configuration:** Intel 486DX2/50, 8MB RAM, Conner 121MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11 **Options:** Intel 486DX4/75 CPU upgrade, \$155, multimedia docking station, \$895, slimline docking station, \$295, docking port, \$95.

AMS Inc., 12881 Ramona Blvd., Irwindale, CA 91706; 800-886-2671, 818-814-8851, fax, 818-814-0782

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SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

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Dell Precision SX2/50 MM MT ... \$1,649.99
#220995

IBM PS1 DX2/50 MM MT ... \$1,999.99
#315124

Packard Bell SX 250 MM #288842 ... \$1,699.99

Packard Bell Pentium MM#288851 ... \$2,499.99

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Compaq 15" .28NI 151 FS ES ... \$496.97
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CompuDyne .39 mm dp #976471 ... \$219.99

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3Com Etherlink III 10BaseT #530580 ... \$129.99

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US Robotics Sportster 14.4 Int w/ Fax ... \$129.99
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• Docking Stations: *Quick Connections*

By Christopher Barr

Can a notebook ever replace your desktop? While today's DX4-based notebooks have more than enough power to run most applications with elan, they require physical connectors to link up with the world. Ranging from minimal port replicators that let you quickly attach to monitors, printers, external keyboards, and mice to full-fledged docking stations that give you access to networks, CD-ROMs, and tape backup, docking stations come in all shapes and sizes.

IN THIS ROUNDUP

We looked at the dock offerings from 11 companies: Aquiline Notebooks, AT&T Global Information Solutions, Broadax Systems, Digital Equipment Corp., FutureTech Systems, IBM Personal Computer Co., MPC Technologies, NEC Technologies, Texas Instruments, Toshiba America Information Systems, and Twinhead Corp.; reviews can be found alongside the reviews of their corresponding notebooks. The docking stations are priced from \$379 to \$899.

We also received six docking stations that weren't evaluated because we didn't review the notebooks that they work with. The \$89 Mini Docking Station from CompuAdd (800-627-1913) has optional Ethernet and SCSI-2 adapters. The \$295 PowerBrick Expansion Chassis from Ergo Computing (800-633-1925) can't accept a disk drive but has two 16-bit slots. The \$489 Elite Docking Station from MidWest Micro (800-682-7256) is identical to MPC Technology's unit (see that review). CAF Technology (818-369-3690) and Wedge Technology (800-872-9334) use the same docking station as Broadax and FutureTech.

Compaq Computer Corp.'s SmartStation and MiniStation docks for its LTE notebooks were not available for

review because their corresponding notebooks are being redesigned. TI's new \$899 Portable CD-ROM Docking Station arrived too late to be included here. It has a built-in CD-ROM drive and speakers, weighs less than 5 pounds, works with products in TI's new 4000M series, and offers a couple hours of battery time.

Another potential bridge between notebook and desktop computing comes from Axonix Corp. (800-866-9797), which makes port replicators and CD-ROM-equipped docking

leader here. Duo Dock pulls the notebook into the docking station as if it were a video tape. Other units require clamping the notebook down and pressing hard to make connections. Of those docking stations reviewed, only the TI TravelMate Desktop Intelligent Docking System used a motorized device. It was also the only unit with a software-triggered detachment, which closes all open applications before shutting down. During testing, we encountered some problems with manual connectors. Motorized devices are



Docking stations come in all shapes and sizes, ranging from minimalist port replicators to full-fledged docking stations with network capabilities and CD-ROM drives.

stations for several notebook makers. Axonix has models for specific Altima, Compaq, Compudyne Products, Gateway 2000, TI, and Toshiba notebooks.

CHOOSE TODAY

Because one size does not fit all and the technologies that drive a notebook and docking station are inextricably linked, you should decide early if you want a notebook cum docking station. Buying a docking station after a notebook can leave you with limited choices. Here are some questions to keep in mind as you shop for the right notebook and docking combination for your needs:

- How easy is it to dock and disconnect? Apple Computer's Duo Dock is the

more reliable.

- What about multimedia options? Multimedia components can be added to virtually all the docking stations here (only Aquiline's Hurricane docking station had no drive bay). In most cases, you'll have to install a SCSI controller to run a CD-ROM drive. Only IBM's and TI's units had built-in SCSI controllers. Three docking stations came with internal IDE controllers.

- How easily does it handle external devices? We found some notebooks' docks had trouble with external devices. The docking stations from Digital and Twinhead each had problems working with an external keyboard. The Twinhead unit wouldn't drive to an external display, and MPC's

unit had to be manually switched between internal and external displays.

- Which notebook models will it work with? Most notebooks usually work with one docking station and possibly a port replicator. Both IBM and Toshiba docks are unique in that they work with a number of different notebooks.

- Does it have all the ports you need? Nearly all the docking stations were equipped with I/O ports for printers, modems, keyboards, and mice. IBM's had external ports for audio in and out, an external floppy drive, and a SCSI device. TI's unit came with everything but the kitchen sink and was the only docking station with PCMCIA slots.

WHAT YOU DON'T GET

You're out of luck if you want a network-ready docking station. Only Twinhead offers an optional Ethernet adapter, though all the docking stations had slots that will accept a network card of your choice. Software that automatically logs you in and out of a network when it recognizes the use of a docking station is also a ways off.

System makers must keep docking options in mind when designing portables. To ensure a smooth connection to all the buses and electrical systems in a notebook, most manufacturers are including proprietary connectors.

As is often the case, the best is yet to come. Microsoft is working on Plug and Play architecture for Chicago (the successor to Windows 3.x), which promises to make hot docking relatively painless. A Plug and Play docking station should dynamically load device drivers and allocate resources, depending upon where it is. To undock under Chicago, all you'll need to do is choose "Eject PC" from a menu. Chicago should gracefully close applications, save files, and sever network connections before detaching. □

AMS Inc.

- **AMS TravelPro 5333**
- **AMS TravelPro 5366**

Austin Direct

- **Austin DX/33 DSTN Color**
- **Austin DX2/66 Active Matrix Color**

Packaged in traditional notebook-size cases, these systems from AMS and Austin Direct offer above-average performance at reasonable prices. The two AMS systems, the AMS TravelPro 5333 and AMS TravelPro 5366, come equipped with the same processor and display combinations and cost \$2,595 and \$3,895, respectively. The two Austin systems—one the Austin DX/33 DSTN Color, a 33-MHz unit with a dual-scan color display, and the other the Austin DX2/66 Active Matrix Color, a 486DX2/66-based unit with an active-matrix color display—cost \$2,698 and \$4,198, respectively.

The AMS and the Austin systems came to us for testing with all of the necessities. Each was equipped with a built-in trackball well placed in the center below the keyboard, two PCMCIA slots, and a removable hard disk. An expansion slot is located at the front base of each system to accommodate the optional docking station that each company offers. Users can easily upgrade memory (from 4MB to 32MB) via a removable panel.

While these four systems do not stray far from the conventional design of a notebook, they do offer all the major trappings and provide solid performance. On our benchmark tests, both sets of systems performed competitively, and for the most part turned in above-average scores within their respective processor classes.

Each of the four systems uses a Western Digital video chip set, and each posted DOS video scores that were above average within its processor group. The DX2/66 units garnered above-average marks on our Graphics WinMark video tests; the DX/33 units turned in average scores. The 33-MHz systems compared rather favorably with the 66-MHz systems on our DOS video tests, but they did lag a bit on our Graphics WinMark tests, due mainly to their slower processors. The 66-

MHz systems weren't as impressive, but they also posted strong numbers.

On our DOS disk and Disk WinMark tests, the AMS TravelPros stole the show—mainly because they were running Microsoft Windows for Workgroups. The TravelPros posted Disk WinMark scores that were competitive with those of systems carrying 100-MHz processors.

Both the AMS and the Austin systems did very well in their processor groups on our Winstone tests. In fact, the 33-MHz AMS system posted the highest Winstone score of its processor group, and the 33-MHz Austin system trailed by a small margin.

These systems differ in battery technology, but all of them posted somewhat disappointing battery times. Austin



► FACT FILE

AMS TravelPro 5333

List price (tested configuration): \$2,595 **Configuration:** Intel 486DX/33, 8MB RAM, Conner 253MB IDE hard disk with 256K cache, 1 44MB floppy disk drive,

14,400 bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11.

Options: Intel DX4/100 CPU upgrade, \$245, Intel DX4/75 CPU upgrade, \$115, docking station, \$295

SUITABILITY TO TASK

DOS applications

GOOD

Windows applications

FAIR

Desktop replacement

GOOD

Road warrior

FAIR

AMS TravelPro 5366

List price (tested configuration): \$3,895 **Configuration:** Intel 486DX2/66, 8MB RAM, Conner 253MB IDE hard disk with 256K cache, 1 44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11

Options: Intel DX4/100 CPU upgrade, \$245, Intel DX4/75 CPU upgrade, \$115, docking station, \$295.

SUITABILITY TO TASK

DOS applications

EXCELLENT

Windows applications

GOOD

Desktop replacement

EXCELLENT

Road warrior

POOR

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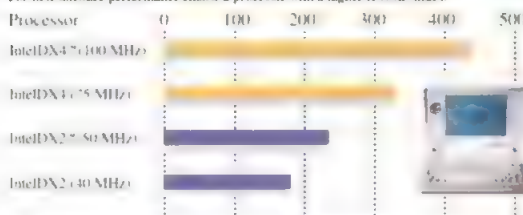
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FACT FILE

Austin DX/33 DSTN Color

List price (tested configuration): \$2,698.

Configuration: Intel 486DX/33 SL, 8MB RAM, Toshiba 262MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

Options: 16MB RAM, \$1,299; docking station, \$299; PCMCIA sound card, \$299; keypad, \$95.

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Austin DX2/66 Active Matrix Color

List price (tested configuration): \$4,198.

Configuration: Intel 486DX2/66, 8MB RAM, Toshiba 340MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1. Options: 16MB RAM, \$1,299; docking station, \$299; PCMCIA sound card, \$299; keypad, \$95.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	EXCELLENT
Road warrior	POOR

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2121 Energy Dr.,
Austin, TX 78758; 800-
752-1577, 512-339-
3500; fax, 512-454-
1357.

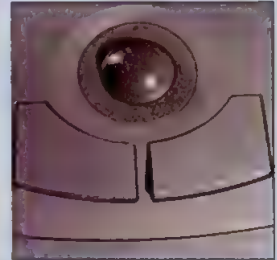
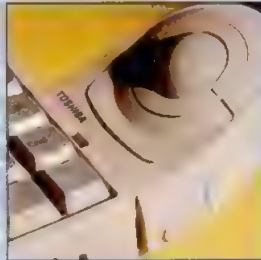
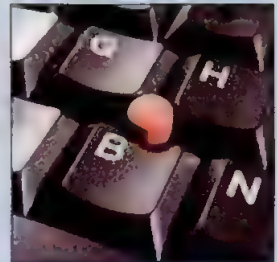
AMS on reader service card

includes nickel cadmium batteries with its units, while AMS opts for longer-running nickel hydride batteries in the TravelPros. Less-than-stellar power management features may have contributed to the units' lackluster performance on our battery tests. The AMS TravelPro 5333 lasted for 2 hours 37 minutes on our battery tests; the Austin DX/33 lasted almost one full hour longer; both 66-MHz units ran for about 2 hours.

Each of these systems is worth looking into, though none offers the sleek appearance or flexibility of newer notebook designs. They are, however, functional and affordable, and they provide more than enough performance.—WPF

Point of View

It's not polite to point, but today's notebooks offer many options. The Apple PowerBook 540c (bottom left) has a touch-sensitive trackpad. Pushing the IBM ThinkPad 755C's TrackPoint II (top right) propels the cursor. The WinBook XP (bottom right) can accept a trackball. Toshiba's T4800CT retains an external trackball (bottom center).



Ambra Computer Corp.

- Ambra N75D
- Ambra N100T

ARM Computer

- ARM TS38
- ARM TS38S
- ARM TS38T

Mitsuba Corp.

- Mitsuba Ninja II TS38M
- Mitsuba Ninja II TS38S

MPC Technologies Inc.

- MPC Model 380 (dual-scan color)
- MPC Model 380 (monochrome)

Four vendors submitted notebooks made by Full Power Investment Co., a Taiwanese concern: Ambra Computer Corp., ARM Computer, Mitsuba Corp., and MPC Technologies. Units ranged from the SX/25-based ARM TS38 to the top-performing DX4/100-based Ambra N100T. Price and performance varied with the type of screen technology, amount of RAM, CPU type, and hard disk size. Battery life ranged from 2 hours 39 minutes for the Ambra N100T to 5 hours 57 minutes for the ARM TS38.

Each unit has a PowerBook-style front-



FACT FILE

Ambra N75D

List price (tested configuration): \$3,448. Configuration:

Intel DX4/75, 8MB RAM, Seagate 340MB IDE hard disk with 16K cache, 1.44MB floppy disk drive, 2,400-/9,600-bps PCMCIA data/fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD
Road warrior	FAIR

Ambra N100T

List price (tested configuration): \$5,748. Configuration: Intel DX4/100, 12MB RAM, Seagate 455MB IDE hard disk with 16K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11. Options: 4MB RAM, \$249; 8MB RAM, \$449; 16MB RAM, \$1,149; docking station, \$399; 14,400-bps PCMCIA fax modem, \$329.

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	EXCELLENT
Desktop replacement	GOOD
Road warrior	FAIR

Ambra Computer Corp.,
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#1000, Raleigh, NC
27604-1063; 800-252-
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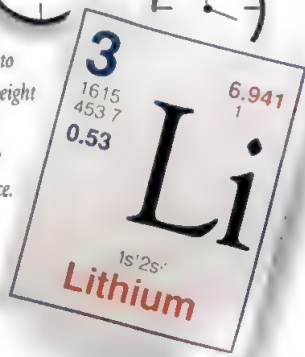


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- VL local-bus video
- Ports: serial, parallel, FDD, and VGA adapter
- Optional Port Replicator

- 3 Year Limited Warranty
- MS-DOS®, Microsoft Windows™, and CommWorks™ for Windows



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mounted trackball and two Type II PCMCIA slots. Screen controls are adjusted via key combinations. All but the 10.3-inch dual-scan passive unit from MPC Technologies have 9.5-inch displays, and all can be equipped with 4MB to 20MB of RAM. Travel weights range from 7 pounds 11 ounces to 8 pounds 6 ounces. Each unit

has a speaker and three tiny holes for a microphone, but only the Ambra units come with an audio chip. The ARM units will also be shipping with audio by the time you read this, however.

Taking top honors on our Winstone, processor, Graphics WinMark, and Disk WinMark tests was the \$5,748 Ambra N100T, with a DX4/100 CPU, 12MB of RAM, and a 455MB hard disk. It also has an active-matrix color screen. A bargain at \$3,448, the Ambra N75D comes with a DX4/75 CPU, 8MB of RAM, and a 340MB hard disk.

Each of the two Ambra units has rear-mounted microphone and speaker jacks and a keyboard-activated speaker-volume control. The only trade-off for the Ambra units' audio ports is the lack of separate keyboard and mouse ports.

The \$1,797 ARM TS38 comes with an SX/25, 8MB of RAM, a 128MB hard disk, and a monochrome display. The \$2,647 ARM TS38S comes with a DX/33 CPU, 8MB of RAM, a 210MB hard disk, and dual-scan color technology. The ARM TS38T sells for \$4,197 and comes with a DX2/66 CPU, 12MB of RAM, a 524MB hard disk, and an active-matrix color display.

Most of the ARM models' test scores were typical for their CPU groups, but the DX2/66-based ARM unit had an exceptionally high Winstone score, which topped scores garnered by several DX4/75-based models from other vendors—including Ambra. The ARM TS38T's 12MB of RAM is the likely reason for this performance. The 25-MHz ARM unit stood out for its near 6 hours of battery life.

The two notebooks from MPC—the \$2,197 MPC Model 380 (monochrome), with a DX2/50 CPU, 8MB of RAM, a 340MB hard disk, and a monochrome screen and the \$2,717 MPC Model 380 (dual-scan color), with a DX2/66 CPU, 8MB of RAM, and a 210MB hard disk—were average performers within their CPU groups. They distinguished themselves with good battery times: 4 hours 27 minutes for the monochrome unit and 3 hours 39 minutes for the color dual-scan color system.

We tested two products in the Mitsuba Ninja II line. The SX/33-based Mitsuba Ninja II TS38M sells for \$1,900 and comes with 8MB of RAM, a 120MB hard disk, and a monochrome screen. For dual-scan



■ MPC 380 Docking Station

MPC Technologies' \$479 docking station comes with everything except a good fit. When connecting, the notebook sits on top of the unit and two manually operated arms force it back onto the connector. This works well for the passive color notebook, but the active color notebook (not reviewed here) is just too tall, and it tends to pull away from the dock.

You can use the notebook in the closed position, since the docking station comes with a display stand that fits over the unit. Both versions of the notebook support VGA resolution internally; externally, the dual-scan passive unit supports a resolution of 1,024-by-768, while the monochrome unit supports 800-by-600; simultaneous display is not supported.

The docking station has all the right ports: one parallel, two serial, VGA, PS/2 mouse, and PS/2 keyboard. The docking station comes with a 3.5-inch floppy disk drive installed, plenty of room for a CD-ROM drive, and two 16-bit slots, which can be used for an audio card, SCSI adapter, graphics card, or other ISA card. —CB

► **MPC 380 Docking Station.** List price: \$479. Options: *Mitsumi CD-ROM drive*, \$359; *Mozart Oak sound card*, \$159; *speakers*, \$40; *Multimedia Center bundle (Mitsumi CD-ROM drive, SoundBlaster 16 sound card, Labtec speakers)*, \$699. MPC Technologies Inc., 2915 Daimler St., Santa Ana, CA 92705-5810; 800-672-8088, 714-724-9000; fax, 714-724-9648.

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► FACT FILE

ARM TS38

List price (tested configuration): \$1,797 **Configuration:** Intel 486SX/25, 8MB RAM, Seagate 128MB IDE hard disk with 64K cache, 1 44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

Options: 4MB RAM, \$219; 8MB RAM, \$469; 16MB RAM, \$1,099; docking station, \$495; nickel cadmium battery, \$89; nickel hydride battery, \$139

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

ARM TS38S

List price (tested configuration): \$2,647 **Configuration:** Intel 486DX/33, 8MB RAM, Seagate 210MB IDE hard disk with 256K cache, 1 44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

ARM TS38T

List price (tested configuration): \$4,197 **Configuration:** Intel 486DX2/66, 12MB RAM, Toshiba 524MB IDE hard disk with 512K cache, 1 44MB floppy disk drive, 14,400 PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	EXCELLENT
Road warrior	FAIR

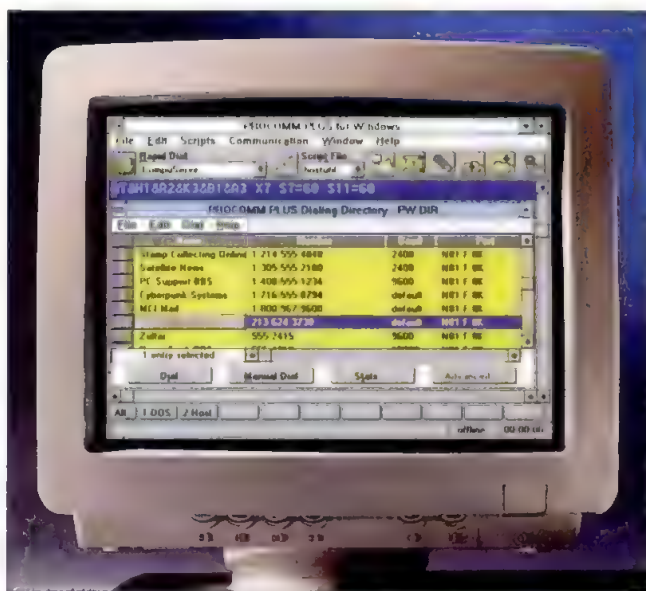
ARM Computer
2149A J. J. Moore Ave.,
San Jose, CA 95131;
800-765-1767, 408-428-9800, fax, 408-428-9528.

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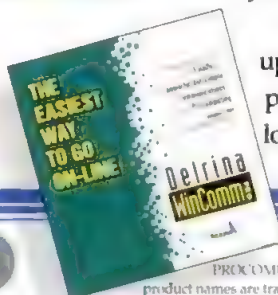
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Phonebook	Customizable	Fixed
Split-screen session window	Yes	No
Scrollbar buffer	200 pages	31 pages
Supports all popular file transfer protocols and terminal emulations	Yes	Yes
Virus detection during download	Yes	No
Shares a COM port with WinFax PRO	Yes	No
Integrated off-line text editor	Yes	No

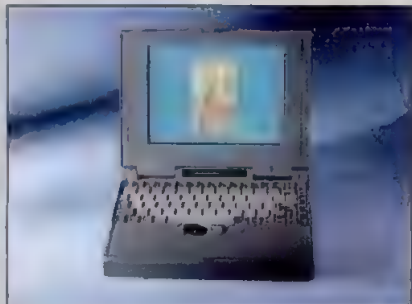
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Mitsuba Ninja II TS38M

List price (tested configuration): \$1,900 **Configuration:** Intel 486SX/33, 8MB RAM, Seagate 120MB IDE hard disk, 1.44MB floppy disk drive, 14,400-/9,600-bps PCMCIA data/fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11 **Options:** 8MB RAM, \$249; 16MB RAM, \$950; docking station, \$495; battery, \$99; external battery charger, \$99

SUITABILITY TO TASKDOS applications **FAIR**Windows applications **FAIR**Desktop replacement **FAIR**Road warrior **FAIR****Mitsuba Ninja II TS38S**

List price (tested configuration): \$2,995 **Configuration:** Intel 486DX2/66, 12MB RAM, Toshiba 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400-/9,600-bps PCMCIA data/fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11 **Options:** 8MB RAM, \$249; 16MB RAM, \$950; docking station, \$495; battery, \$99; external battery charger, \$99.

SUITABILITY TO TASKDOS applications **GOOD**Windows applications **GOOD**Desktop replacement **EXCELLENT**Road warrior **FAIR**

Mitsuba Corp., 1925 Wright Ave., La Verne, CA 91750; 800-648-7822, 909-392-2000, fax, 909-392-2021.

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color, 12MB of RAM, a DX2/66 CPU, and a 340MB hard disk, you might want to look at the \$2,995 Mitsuba Ninja II TS38S. The price is right considering this system's outstanding performance.

Within their CPU groups, both Ninjas did well: above average on our Disk WinMark tests and average on our Graphics WinMark tests. The SX/33-based system took second place in its CPU group on our Winstone tests, but even this fine showing was topped by that of the DX2/66-based model, which posted the third-highest Winstone score here. The Ninjas also had good battery times: 3 hours 15 minutes for the color DX2/66-based system and 5 hours 16 minutes for the monochrome SX/33-based unit.

—Bruce Brown

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MPC Model 380 (dual-scan color)

List price (tested configuration): \$2,717.

Configuration: Intel 486DX2/66, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

MPC Model 380 (monochrome)

List price (tested configuration): \$2,197.

Configuration: Intel 486DX2/50, 8MB RAM, Toshiba 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.11. **Options:** 4MB RAM module, \$219; docking station, \$479; multimedia center (includes docking station, CD-ROM drive, sound card, and speakers), \$699.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

MPC Technologies Inc.,
2915 Daimler St., Santa
Ana, CA 92705-5810;
800-672-8088, 714-724-
9000; fax, 714-724-
9648.

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color screen, 20MB of RAM, and a 340MB hard disk; a \$3,995 DX4/75-based model with a dual-scan passive-matrix color display, 20MB of RAM, and a 524MB drive; and a DX4/100-powered line leader with 20MB of RAM, an active-matrix color screen, a 524MB hard disk, and a \$4,995 price



► FACT FILE

Aquiline Hurricane DX2/66 Multimedia Notebook

List price (tested configuration): \$4,495. **Configu-**

ation: Intel 486DX2/66, 20MB RAM, Toshiba 340MB IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Aquiline Hurricane DX4/75 Multimedia Notebook

List price (tested configuration): \$3,995. **Configu-**

ation: Intel DX4/75, 20MB RAM, Toshiba 524MB IDE hard disk with 512K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.11.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	EXCELLENT
Desktop replacement	EXCELLENT
Road warrior	FAIR

Aquiline Hurricane DX4/100 Multimedia Notebook

List price (tested configuration): \$4,995. **Configu-**

ation: Intel DX4/100, 20MB RAM, Toshiba 524MB IDE hard disk with 512K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1. **Options:** 16MB RAM upgrade, \$1,495; full-size internal CD-ROM drive, \$1,995.

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	EXCELLENT
Desktop replacement	EXCELLENT
Road warrior	POOR

Aquiline Notebooks,
701 River St., Troy,
NY 12180; 518-272-
0421; fax, 518-272-
0547.

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■ Aquiline Hurricane Docking Station

Aquiline Notebooks' \$395 Aquiline Hurricane Docking Station is an inexpensive, minimalist approach to transforming your notebook into a desktop PC. It offers connectivity that goes only slightly further than that provided by a good port replicator.

The case is made of heavy-gauge steel, and the notebook is locked to it with a mechanism that attaches to the bottom of the notebook. The poor quality of the construction ensures that you won't be happy to deal with this station or proud to show it off. On the positive side, the unit is angled, which puts the docked notebook at a comfortable slant. An internal socket can be used for a network card or SCSI adapter, and one 16-bit slot is available. This is not a multimedia docking station; there is no room for an internal hard disk, floppy disk drive, or CD-ROM drive.

The Hurricane Docking Station comes with two serial ports and one parallel, one PS/2 keyboard, and one VGA port, but it does not have a mouse port. The Aquiline notebook can support external VGA resolutions up to 1024-by-768, but you must run the VGAMODE utility every time you use an external VGA display. There's no way to add it to the notebook's setup routine.—*Christopher Barr*

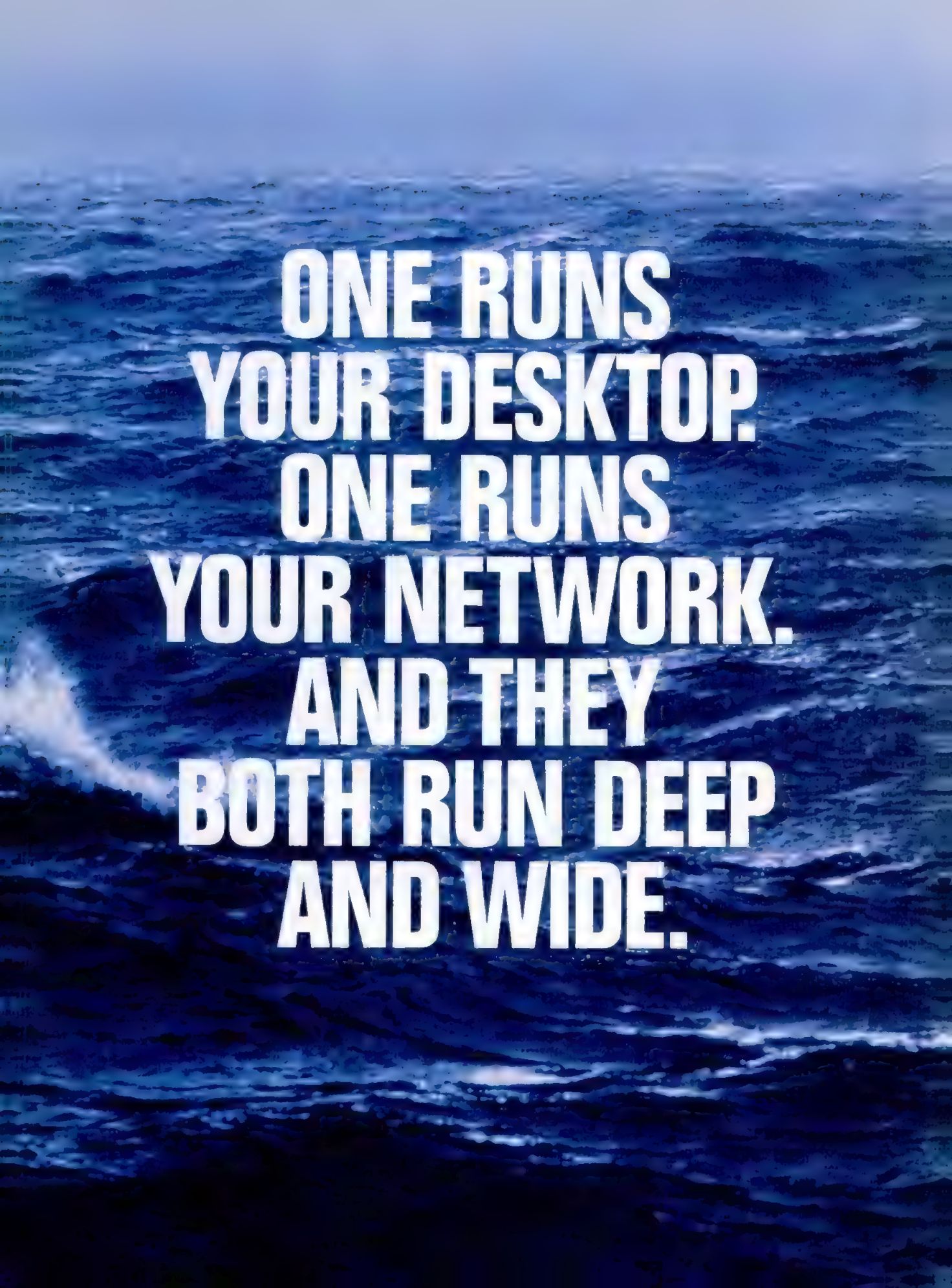
► **Aquiline Hurricane Docking Station.** List price: \$395. Aquiline Notebooks, 701 River St., Troy, NY 12180; 518-272-0421; fax, 518-272-0547.

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Aquiline Notebooks

- Aquiline Hurricane DX2/66 Multimedia Notebook
- Aquiline Hurricane DX4/75 Multimedia Notebook
- Aquiline Hurricane DX4/100 Multimedia Notebook

As their name implies, the Aquiline Hurricane Multimedia notebooks come with built-in audio, making them well suited for portable presentations. The company sent us three different models, which are indicative of the range of products available: a DX2/66-based version for \$4,495 with an active-matrix



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Battery Life vs. Portability

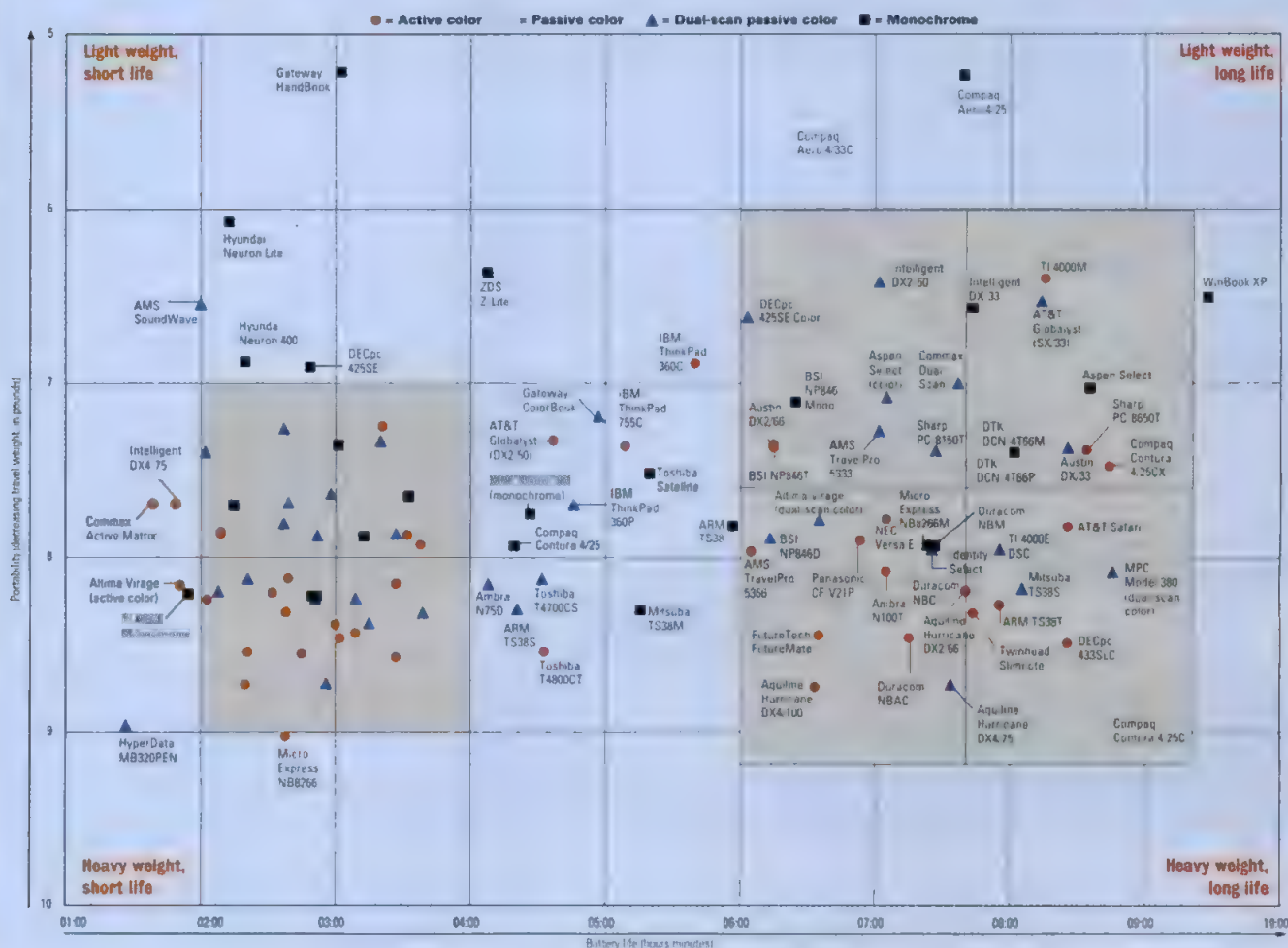
Three notebooks led the pack as top road warriors: the Compaq Contura Aero 4/25 Model 84, the Compaq Contura Aero 4/33C Model 170, and the WinBook XP DX2/50 4/260 Monochrome.

The WinBook XP posted an

unprecedented battery life of 9 hours 28 minutes, and though its dimensions are those of a regular-size notebook, its weight is closer to that of a subnotebook. The two Compaq Aero systems are subnotebooks with regard to both size and weight; they ranked second

and third, respectively, in terms of battery life per pound of battery weight.

The IBM ThinkPad 360C and IBM ThinkPad 755C fell in the top ten of our battery life/portability ratings. Surprisingly, the passive color IBM ThinkPad



tag—one of two DX4/100-based systems in this roundup.

All the Aquiline Hurricane units were priced competitively based on their respective mixtures of components and features, and most of them did well on our benchmark tests. The Aquiline Hurricanes earned particularly high scores on our Winstone and Graphics WinMark measures; the DX4-based units were in

the top five on those tests. The DX2/66-based unit was the exception, with average scores on the DOS-based tests and lower than average scores for its processor group on our Graphics WinMark, Winstone, and Disk WinMark tests.

All the Aquiline Hurricane units integrate a 16-bit Sound Blaster-compatible audio chip, microphone and headphone jacks, and volume control.

The computers can also display 1,024-by-768 resolution images on an external monitor via a VGA port while showing 640-by-480 resolution on the systems' native 9.5-inch diagonal screens.

Inexpensive but very portable KOSS speakers are also standard (internal speakers will be included by fall), as is a 14,400-bps AT&T Paradyne fax modem that plugs into one of the two Type II

360P just missed the top ten, because its battery life was about 1 hour shorter than that of the active color IBM ThinkPad 360C.

The HyperData MB320PEN isn't

the greatest road warrior: Its battery lasted for only an hour and a half, and it is the second-heaviest system in the roundup. The Commax Smartbook II Active Matrix, Altima Virage (active

color), and TI TravelMate 4000E WinDX2/50 Monochrome join the HyperData HB320PEN at the bottom of the heap, with battery lives of under 2 hours and hefty travel weights.

	Travel weight	Battery life (hours:minutes)	Battery weight	Battery life per pound of battery weight (hours:minutes)
Altima Virage (active color)	8 lbs 3 oz.	1:51	1 lb 2 oz.	1:39
Altima Virage (dual-scan color)	8 lbs 2 oz.	2:21	1 lb 2 oz.	2:07
Ambra N75D	8 lbs 2 oz.	4:08	1 lb 5 oz.	3:12
Ambra N100T	8 lbs 5 oz.	2:38	1 lb 5 oz.	2:02
AMS SoundWave	6 lbs 8 oz.	2:00	1 lb 5 oz.	2:49
AMS TravelPro 5333	7 lbs 13 oz.	2:37	1 lb 4 oz.	2:04
AMS TravelPro 5366	8 lbs 3 oz.	2:03	1 lb 4 oz.	1:37
Aquiline Hurricane DX2/66	8 lbs 6 oz.	3:00	1 lb 8 oz.	2:00
Aquiline Hurricane DX4/75	8 lbs 11 oz.	2:56	1 lb 8 oz.	1:57
Aquiline Hurricane DX4/100	8 lbs 11 oz.	2:20	1 lb 8 oz.	1:33
ARM TS38	7 lbs 13 oz.	5:57	1 lb 12 oz.	3:27
ARM TS38S	8 lbs 5 oz.	4:21	1 lb 11 oz.	2:32
ARM TS38T	8 lbs 6 oz.	3:09	1 lb 12 oz.	1:49
Aspen Select (monochrome)	7 lbs 10 oz.	3:33	1 lb 2 oz.	3:11
Aspen Select (color)	7 lbs 11 oz.	2:39	1 lb 2 oz.	2:22
AT&T Globalyst (DX2/50)	7 lbs 5 oz.	4:37	1 lb.	4:31
AT&T Globalyst (SX/33)	7 lbs 2 oz.	3:20	1 lb.	3:15
AT&T Safari	8 lbs 2 oz.	3:27	1 lb 2 oz.	3:06
Austin DX/33	7 lbs 14 oz.	3:27	1 lb 5 oz.	2:36
Austin DX2/66	7 lbs 13 oz.	2:09	1 lb 5 oz.	1:38
BSI NP846 Mono	7 lbs 11 oz.	2:15	1 lb 6 oz.	1:38
BSI NP846D	8 lbs 3 oz.	2:08	1 lb 6 oz.	1:33
BSI NP846T	7 lbs 14 oz.	2:09	1 lb 6 oz.	1:34
Commax Active Matrix	7 lbs 11 oz.	1:39	1 lb 2 oz.	1:29
Commax Dual Scan	7 lbs 10 oz.	2:58	1 lb 2 oz.	2:39
Compaq Contura Aero 4/25	5 lbs 3 oz.	7:40	1 lb.	7:30
Compaq Contura Aero 4/33C	5 lbs 6 oz.	6:28	1 lb.	6:19
Compaq Contura 4/25	7 lbs 14 oz.	4:20	1 lb 4 oz.	3:28
Compaq Contura 4/25C	8 lbs 13 oz.	3:45	1 lb 2 oz.	3:22
Compaq Contura 4/25CX	7 lbs 14 oz.	3:38	1 lb 4 oz.	2:54
DECpc 425SE	6 lbs 14 oz.	2:49	1 lb.	2:45
DECpc 425SE Color	7 lbs 6 oz.	2:02	1 lb.	1:58
DECpc 433SLC Premium	8 lbs 10 oz.	3:27	1 lb 9 oz.	2:12
DTK DCN-4T66M	7 lbs 14 oz.	3:13	1 lb 7 oz.	2:14
DTK DCN 4T66P	7 lbs 14 oz.	3:01	1 lb 7 oz.	1:57

Note: All numbers have been rounded.

	Travel weight	Battery life (hours:minutes)	Battery weight	Battery life per pound of battery weight (hours:minutes)
Duracom NBAC	8 lbs 8 oz.	2:45	1 lb 11 oz.	1:37
Duracom NBC	8 lbs 5 oz.	2:45	1 lb 15 oz.	1:23
Duracom NBM	8 lbs 3 oz.	2:52	1 lb 11 oz.	1:41
FutureTech FutureMate	8 lbs 8 oz.	2:21	1 lb 6 oz.	1:43
Gateway ColorBook	7 lbs 3 oz.	4:57	1 lb 4 oz.	3:53
Gateway HandBook	5 lbs 3 oz.	3:03	8 oz.	5:44
HyperData MB320PEN	9 lbs.	1:27	1 lb 4 oz.	1:10
Hyundai Neuron 400	6 lbs 14 oz.	2:20	15 oz.	2:25
Hyundai Neuron Lite	6 lbs 2 oz.	2:13	15 oz.	2:23
IBM ThinkPad 360C	6 lbs 14 oz.	5:40	1 lb 3 oz.	4:47
IBM ThinkPad 360P	7 lbs 11 oz.	4:46	1 lb 3 oz.	4:02
IBM ThinkPad 755C	7 lbs 6 oz.	5:08	1 lb 4 oz.	4:07
Identity Select	8 lbs 3 oz.	2:51	1 lb 2 oz.	2:33
Intelligent DX4 75	7 lbs 11 oz.	1:49	1 lb 4 oz.	1:27
Intelligent DX2-50	7 lbs 3 oz.	2:37	1 lb 4 oz.	2:06
Intelligent DX-33	7 lbs 6 oz.	3:02	1 lb 4 oz.	2:25
Micro Express NB8266	9 lbs.	2:38	1 lb 11 oz.	1:33
Micro Express NB8266M	8 lbs 3 oz.	2:50	1 lb 11 oz.	1:40
Mitsuba TS38M	8 lbs 5 oz.	5:16	1 lb 12 oz.	3:03
Mitsuba TS38S	8 lbs 6 oz.	3:15	1 lb 12 oz.	1:53
MPC Model 380 (dual-scan color)	8 lbs 5 oz.	3:39	1 lb 12 oz.	2:07
MPC Model 380 (monochrome)	7 lbs 11 oz.	4:27	1 lb 12 oz.	2:35
NEC Versa E	8 lbs 2 oz.	2:39	1 lb 2 oz.	2:23
Panasonic CF-V21P	8 lbs 3 oz.	2:32	12 oz.	3:31
Sharp PC-8150T	7 lbs 14 oz.	2:52	1 lb 8 oz.	1:55
Sharp PC-8650T	7 lbs 14 oz.	3:32	1 lb 8 oz.	2:22
TI 4000F DSC	8 lbs 3 oz.	3:09	1 lb 5 oz.	2:24
TI 4000E Monochrome	8 lbs 3 oz.	1:55	1 lb 5 oz.	1:28
TI 4000M	7 lbs 3 oz.	3:21	1 lb 5 oz.	2:29
Toshiba Satellite	7 lbs 8 oz.	5:20	1 lb 4 oz.	4:13
Toshiba T4700CS	8 lbs 2 oz.	4:32	1 lb 4 oz.	3:35
Toshiba T4800CT	8 lbs 8 oz.	4:33	1 lb 4 oz.	3:34
Twinhead Slimnote	8 lbs 8 oz.	3:02	1 lb 8 oz.	2:01
WinBook XP	8 lbs 8 oz.	9:28	1 lb 4 oz.	7:37
ZDS Z Lite	6 lbs 8 oz.	4:08	15 oz.	4:32

PCMCIA slots. A trackball is embedded in the wrist rest located in front of the keyboard.

If you intend to do a lot of traveling, you should note that the two DX4-based notebooks are heavy at best, tipping the scales with travel weights of 8 pounds 11 ounces. Battery life was average to disappointing during testing: The two lower-power systems attained close to

the rated 3-hour battery life, while the DX4/100-based unit lasted just about 2 hours 20 minutes.

The nickel hydride battery may deliver a longer run time if you utilize the extensive power management options, including system dozing, auto suspend mode, hard disk and display backlight standby modes, and selectable COM port power-down. So that the notebook can

act as an all-day/all-night fax machine, you can set the system to come out of suspend mode if the on-board modem receives a call.

Adding fast processors and lots of memory isn't exactly a new way to get high computer performance, but Aquiline uses this strategy to good advantage in its Hurricane Multimedia Notebook line.—BB

AT&T Global Information Solutions

● AT&T Safari 3181

NEC Technologies Inc.

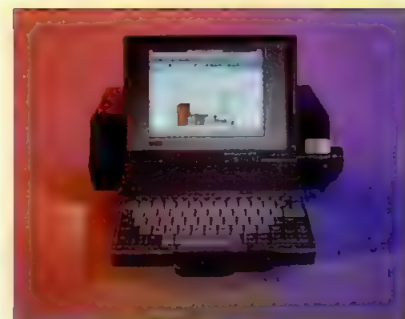
● NEC Versa E Series
DX4/75

The \$4,798 AT&T Safari 3181 and the \$6,367 NEC Versa E Series DX4/75 from AT&T Global Information Solutions and NEC Technologies, respectively, offer the user an unparalleled array of upgrade and expansion options. They pay the price for

The only real design flaw is the placement of the trackball. Vertically mounted in the front of the system, the ball is somewhat small and extremely awkward to use.

The AT&T Safari 3181 came configured with 12MB of system memory; the NEC Versa E came with 8MB of system memory installed. As far as performance goes, the systems had mixed results. The DX2/50-equipped AT&T Safari 3181 posted the lowest score on our processor tests in its chip group. This score, combined with its low DOS disk score, contributed to a poor DOSmark result.

The AT&T Safari 3181's overall performance was highlighted by strong video scores, however. Its DOS video score was the best of the DX2/50 units, and its Graphics WinMark score was second to that of the AT&T Globalyst 200 (DX2/50). In these areas of testing, the system was helped out by its Western Digital video chip set. Its Disk WinMark score was below average,

■ AT&T Safari,
NEC Versa

The \$730 AT&T Safari Docking Station and the \$629 NEC Docking Station are made by NEC and are compatible with the AT&T Safari 3180 and 3181, and with notebooks in the NEC Versa E Series. These docking stations were some of the better equipped ones we saw.

They offer plenty of room for growth: three drive bays, including an internal 3.5-inch bay and two 5.25-inch bays. Each dock also has an IDE controller.

Ports include one enhanced parallel, one serial, and one VGA. The front carries a PS/2 mouse port, PS/2 keyboard port, and headphone and microphone jacks. There are also two 16-bit slots inside.

The notebook slips into the docking station manually and attaches to the connector easily. The notebook has display drivers that support resolutions of up to 1,024-by-768 and can detect an attached external display, but you can install a second graphics adapter in the docking station and use either as the primary video source.—CB

► **AT&T Safari Docking Station.** List price: \$730. AT&T Global Information Solutions, 1700 S. Patterson Blvd., Dayton, OH 45479-0001; 800-637-2600, 513-445-5000.

Circle 548 on reader service card

► **NEC Versa Docking Station.** List price: \$629. NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-632-4636, 508-264-8000; fax, 508-264-8831.

Circle 131 on reader service card



► FACT FILE

AT&T Safari 3181

List price (tested configuration): \$4,798

Configuration: Intel 486DX2/50, 12MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 Options: Docking station, \$730, cable manager, \$105

AT&T Global Information Solutions, 1700 S. Patterson Blvd., Dayton, OH 45479-0001, 800-225-5627, 513-445-5000

466 on reader service card

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**



► FACT FILE

NEC Versa E Series DX4/75

List price (tested configuration): \$6,367

Configuration: Intel DX4/75, 8MB RAM, IBM 340MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 Options: 4MB RAM, \$309, 8MB RAM, \$629, 12MB RAM, \$1,069, 16MB RAM, \$2,499, color TouchPen screen upgrade, \$699; docking station, \$629, port replicator, \$99; nickel hydride battery, \$199, AC adapter, \$99.

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-632-4636, 508-264-8000; fax, 508-264-8831.

477 on reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Desktop replacement **EXCELLENT**

Road warrior **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **AVERAGE**

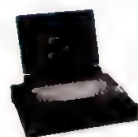
Technical support **AVERAGE**

this modularity, however, with less-than-stellar performance and increased weight and bulk.

The flexibility of the systems' design is unmatched by that of any system in this roundup. The hard disk and the floppy disk drive in each are removable, the screen can be removed for upgrades or turned around for use in a presentation, and memory upgrades are facilitated by proprietary memory cards purchased from the respective vendor; there is even a pen-based screen upgrade available. An optional docking station further increases opportunities for system expansion (see the review on this page).

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Built-in Center Trackball



TravelPro 5300
January 1994



Recommended
Vol. 8 No. 1 January 1994



TravelPro 5300
March 1994

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MSD TYPE	Company Config	Ball Latitude	Company Config	MSD TYPE	Ball Latitude	AMS TravelPro 5300
No	No	No	No	No	No	No
20MB	20MB	20MB	20MB	20MB	20MB	32MB
340MB	340MB	340MB	340MB	340MB	340MB	520MB
1024x768	800x600	800x600	800x600	1024x768	1024x768	1280x1024
486SX-25	486SX-25	486SX-25	486SX-25	486DX2-50	486DX2-50	486DX4-100
1024x768	800x600	800x600	800x600	800x600	800x600	1024x768
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

*All Specifications based on Mfg. advertising as of preparation. All Registered Trademarks and TradeNames are the properties of their respective company.

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**HEWLETT
PACKARD**



however, and its Winstone score was low but still competitive. The AT&T Safari 3181's battery life was a respectable 3 hours 27 minutes; the NEC Versa E lasted just over 2 hours 30 minutes.

The NEC Versa E also proved to be a strong graphics system but a poor performer on our other benchmark tests. The unit's Western Digital video chip set boosted the unit's DOS video and Graphics WinMark scores, but its Winstone and Disk WinMark scores were well below the

scores posted by most of the other DX4/75-based systems in this roundup. The DOSmark result was the lowest of the DX4/75 group, in part because of the unit's below-average DOS disk and processor scores.

The AT&T Safari 3181 and the NEC Versa E are well suited for presentations and other graphics-based tasks. The trade-off is high for this kind of modularity, however, so look to these machines if your needs for flexibility outweigh your demands for high performance.—WPF

AT&T Global Information Solutions

• AT&T Globalyst 200

(DX2/50)

• AT&T Globalyst 200

(SX/33)

The AT&T Globalyst 200 is an impressive notebook line. Whether you choose the \$4,105 active-matrix color AT&T

• Coming Attractions

When it comes to notebooks, we're always looking ahead. What's new? and What's next? are two questions frequently asked by our readers, and for our part, we try to answer them as best we can in a timely manner. Here are seven new and interesting systems that escaped our testing this time around.



▲ AcerNote 780CX

The \$3,999 AcerNote 780CX sports a DX4/75 processor, crisp 9.5-inch active color screen, and a responsive 19-mm trackball. 800-368-2237



▲ Austin DX4/100

This 8.2-pound DX4/100-based unit offers a removable 524MB hard disk, 16MB of RAM, and an active color screen, all for \$4,999. 800-752-1577



▲ Sager Midern NP3656T

This 66-MHz Pentium unit features a 9.5-inch active TFT display; on the downside, travel weight approaches a hefty 10 pounds. 800-669-1624



▲ Toshiba T2400C

The active color T2400C offers an integrated pointing device, external SCSI-2 port, 486DX2/50 CPU, and a 320MB hard disk. 800-334-3445



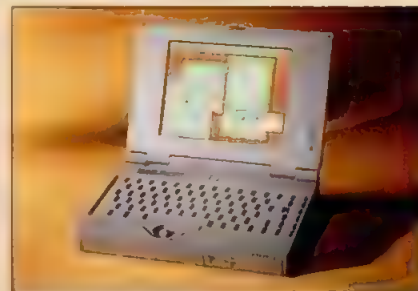
▲ Toshiba Portégé T3600CT

At 4.4 pounds with 8 4-inch active color, local-bus video, the DX2/50-based \$4,799 Toshiba Portégé T3600CT is light but powerful. 800-334-3445



▲ Winbook XP DX4/75

This \$3,600 active color notebook is the first with 512K of external cache and provides a nice mix of price and performance. 800-293-1641



▲ ZDS Z-Noteflex

The Z-Noteflex will accommodate up to an Intel 100-MHz DX4 CPU and comes with local-bus video and IDE hard disk subsystems. 708-808-5000

Globalyst 200 (DX2/50) or the \$2,700 dual-scan passive-matrix AT&T Globalyst 200 (SX/33), you get a crisp display characterized by strong graphics performance under Windows and adequate performance in the DOS arena.

Though not as flexible as systems in the AT&T Safari 3181 line, Globalyst 200 systems do have their own unique design that is visually appealing. With the Globalyst 200 systems, AT&T took PCMCIA technology a small but logical step further. Each Globalyst 200 unit has two PCMCIA slots, and while this is not unusual, one of the sockets is Type II and one is Type III. This allows the installation of one Type I or Type II card and one Type III card at the same time. Most other designs allow for two Type I or

Type II cards, or one Type III card. One advantage of this setup is it allows you to have your Type II modem installed at the same time as your Type III storage or I/O device. Also, unlike the trackball found with the AT&T Safari 3181, the Globalyst 200 trackball is smartly placed in the center just in front of the keyboard and offers some pleasant resistance moving through Windows.

These machines turned in strong performance on our Graphics WinMark tests and posted above-average Winstone scores. The DX2/50 managed a Graphics WinMark score of 5.0 million pixels per second and a Winstone score of 32.7; the SX/33's Graphics WinMark score was an impressive 4.6 million pixels per second, and its Winstone score was 28.6. Both showings were due in part to each unit's Western Digital video chip set.

On our DOS-based tests, each system performed on a par with systems in its processor class. The DX2/50 unit's processor score was average in its chip class, but its Western Digital hard disk helped it post the best disk score overall, which in turn boosted its DOSmark score.

These are well-designed systems with outstanding graphics performance under Windows. Unfortunately, their high prices may scare many potential buyers away.—WPF

Broadax Systems Inc.

- **BSI NP846 Mono**
- **BSI NP846D**
- **BSI NP846T**

FutureTech Systems Inc.

- **FutureTech FutureMate 462nV**

When we last looked at color notebooks six months ago, entries from Broadax Systems and FutureTech Systems (both vendors are resellers of units made by Nan Tan Computer Co.) were top performers. But time has brought many technological advances to the portables market, and Broadax and FutureTech have not kept up. These vendors' notebooks just couldn't compete against the other DX2/66-based entries in this roundup, and their aging designs and relatively high prices only serve to hinder them.



• BSI NP800, FutureTech FutureDock

Broadax Systems and FutureTech Systems use docking stations made in Taiwan by Nan Tan Computer Co. Broadax offers the unit for \$465; FutureTech offers it for \$469.

These docking stations each have four 16-bit slots—two with VL-Bus extensions in the Broadax version. Each has room for an optional CD-ROM drive and an internal 3.5-inch floppy disk drive. The Broadax unit came with a CD-ROM drive, a sound card, and two external speakers, all for \$350 more than the list price.

Each includes one parallel, two serial, one VGA, and a PS/2 port for a mouse or keyboard. Audio input jacks connect to two internal speakers, but these may prove awkward to use because you must run a cable from an optional audio card to the input jacks.

The notebook sits on top of the docking station. The closing mechanism consists of two levers that force the notebook back into the case; then two locking buttons secure it.—CB

► **BSI NP800 Multimedia Docking Station.** List price: \$465. Broadax Systems Inc., 9440 Telstar Ave., #4, El Monte, CA 91731; 800-872-4547, 818-442-0020; fax, 818-442-4527.

Circle 549 on reader service card

► **FutureTech FutureDock.** List price: \$469. FutureTech Systems Inc., Six Bridge St., Hackensack NJ 07601; 800-275-4414, 201-488-4414; fax, 201-488-4405.

Circle 479 on reader service card



▶ FACT FILE

AT&T Globalyst 200 (DX2/50)

List price: \$4,105 **Configuration:** Intel 486DX2/50, 8MB RAM, Western Digital 250MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.11.

Options: Quick Dock docking station, \$95; Power Dock docking station, \$225.

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

AT&T Globalyst 200 (SX/33)

List price: \$2,700 **Configuration:** Intel 486SX/33, 8MB RAM, Western Digital 170MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.21, Microsoft Windows 3.11 **Options:** Quick Dock docking station, \$95, Power Dock docking station, \$225

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

AT&T Global Information Solutions, 1700 S. Patterson Blvd., Dayton, OH 45479-0001, 800-225-5627, 513-445-5000

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- ▲ VESA Local Bus IDE Hard Drive Controller
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- ▲ VESA Local Bus Graphics Accelerator 1MB
- ▲ VESA Local Bus IDE Hard Drive Controller
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- ▲ 16-bit Sound Card and 2 Speakers
- ▲ Borland Office™ on CD
- ▲ Productivity Pack
- ▲ 4 16-bit ISA and 1 32-bit VL Bus Slots
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.1, Mouse
- ▲ One-Year IBM Onsite Service

3 D4100 I/VL \$2799 Business Lease: \$99/Month

- ▲ 100MHz Intel DX4 Processor, Desktop
- ▲ Upgradable to PCI and Pentium Technology
- ▲ 16KB L1, 256KB L2 Cache, Write-Back
- ▲ 16MB RAM, Max: 64MB
- ▲ 720MB IDE Hard Disk Drive
- ▲ 14" SVGA Color Monitor-LR
- ▲ VESA Local Bus Graphics Accelerator 2MB
- ▲ VESA Local Bus IDE Hard Drive Controller
- ▲ 4 16-bit ISA and 1 32-bit VL Bus Slots
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▲ 17" FST-NI Color Monitor	\$699
▲ 1MB Video Memory Upgrade	\$69
▲ 5.25" Floppy Drive	\$60
▲ 1GB IDE Disk Drive	\$699



InfoWorld, April 4, 1994

1. Follow instructions on the other side

Back

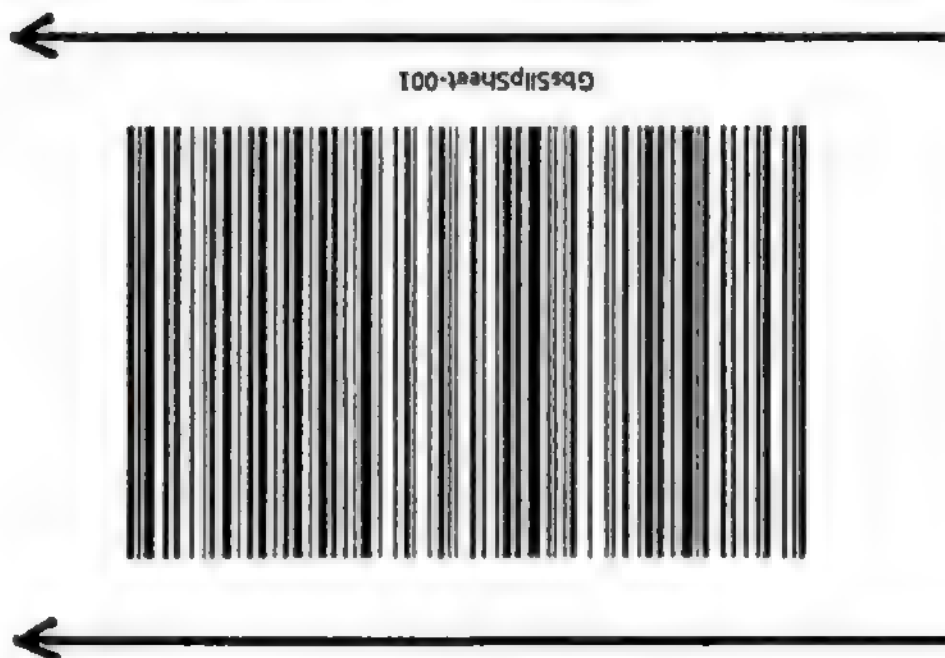
GBS5lipBack-0018



Inverted Back

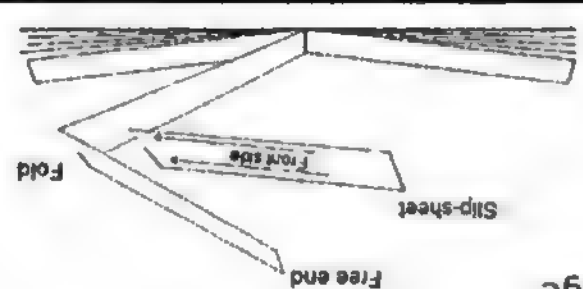
1. Follow instructions on the other side

Folded edge of the page

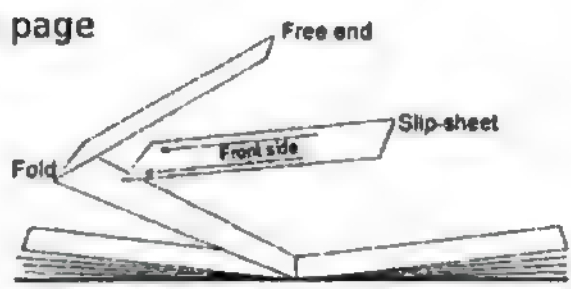


Inverted Foldout slip-sheet

Foldout slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
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- ▲ One-year warranty on parts and labor.
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THE BLUE.

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It's ideal for those who travel the fast track. Driven by a fast Intel DX4 100MHz processor, the N100 is a blur. The screen, however, is sharp and vivid—thanks to a 9.5-inch active matrix (TFT) display. Combined with the integrated audio playback and record functions, your multimedia presentations will be very sharp indeed. The N100 may be small, but it packs an impressive list of features. Such as a 450MB hard drive. An 85-key, full-size keyboard. And



Full-size keys mean fewer typos. And that should speed things up even more.

an integrated, easy-to-use 16mm trackball. All at a flyweight price. And all to help you fly through your workload.



These notebooks pack a lot of power into a scant 6.7 pounds



6 N75D-340 \$3199 Business Lease: \$114/Month

- ▲ 75MHz Intel DX4
- ▲ 340MB Hard Disk Drive, Upgradable
- ▲ 10.3" Dual Scan DSTN Color Display with Local Bus Video and 1MB Video RAM
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- ▲ 85-Key Keyboard
- ▲ Centered 16mm Trackball
- ▲ Integrated Audio (Speaker and Microphone)
- ▲ System Status Panel
- ▲ 6.7 Pounds, Including NiMH Battery
- ▲ MS-DOS 6.2
- ▲ Windows for Workgroups 3.11
- ▲ Includes AC Adapter and Case

7 N75T-340 \$4299 Business Lease: \$152/Month

- ▲ 75MHz Intel DX4
- ▲ 340MB Hard Disk Drive, Upgradable
- ▲ 9.5" Active Matrix TFT Color Display with Local Bus Video and 1MB Video RAM
- ▲ 4MB RAM, Max: 20MB
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Type III PCMCIA Slot (1 Type III/ 2 Type II)
- ▲ 85-Key Keyboard
- ▲ Centered 16mm Trackball
- ▲ Integrated Audio (Speaker and Microphone)
- ▲ System Status Panel
- ▲ 6.7 Pounds, Including NiMH Battery
- ▲ MS-DOS 6.2
- ▲ Windows for Workgroups 3.11
- ▲ Includes AC Adapter and Case

8 N100T-450 \$5299 Business Lease: \$187/Month

- ▲ 100MHz Intel DX4
- ▲ 450MB Hard Disk Drive, Upgradable
- ▲ 9.5" Active Matrix TFT Color Display with Local Bus Video and 1MB Video RAM
- ▲ 4MB RAM, Max: 20MB
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Type III PCMCIA Slot (1 Type III/ 2 Type II)
- ▲ 85-Key Keyboard
- ▲ Centered 16mm Trackball
- ▲ Integrated Audio (Speaker and Microphone)
- ▲ System Status Panel
- ▲ 6.7 Pounds, Including NiMH Battery
- ▲ MS-DOS 6.2
- ▲ Windows for Workgroups 3.11
- ▲ Includes AC Adapter and Case

N100 AND N75 OPTIONS

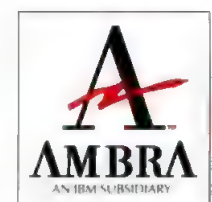
- ▲ 4MB Memory \$249
- ▲ 8MB Memory \$449
- ▲ 16MB Memory \$1149
- ▲ NiMH Battery \$139
- ▲ Battery Charger \$99
- ▲ 12Volt DC Auto Adapter \$79
- ▲ AC Adapter \$89
- ▲ Docking Station \$399
- ▲ Deluxe Carrying Case \$99
- ▲ N100T/N75T Extended Warranty \$349
- ▲ N75D Extended Warranty \$299



IntoWorld, May 23, 1994



1800-200-1465



ANCED, EVEN YOUR DOLL

The Pentium Systems Of Choice.

"The AMBRA Pentium PCI Desktop makes it clear that this is the new Windows/Multimedia system standard."

—Windows Sources, April 1994

At last, you can get the new standard of power, the Pentium CPU. And with the widest range of peripherals to harness this power, AMBRA's where you should get it. Choose your fast PCI video card. Add hard drive capacity up to 4GB; mini-tower, up to 6GB. With PCI/IDE or PCI/SCSI controllers for faster throughput, you'll get transfer rates of up to 11MB/sec. And Pentium systems are compatible with over 50,000 legacy X86 applications. It all adds up to workstation-like performance at 486 prices. You get the idea. We suggest you get on the phone.



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Get A Free Upgrade From A 14" To A 15" FST Monitor With The Purchase Of Any AMBRA System Below.¹



InfoWorld, March 14, 1994

4 DP60PCI \$2599 Business Lease: \$92/Month

- ▲ Intel 60MHz Pentium CPU
- ▲ 64-bit CPU-Memory-Cache Data Path
- ▲ 256KB L2 and 16KB L1 Cache
- ▲ 8MB RAM, Max: 128MB
- ▲ 720MB IDE Hard Disk Drive
- ▲ 14" SVGA Color Monitor-LR
- ▲ Phantom 32P PCI Graphics Accelerator 2MB
- ▲ Double-Speed Multisession CD-ROM Drive
- ▲ 4 ISA, 2 PCI and 1 ISA/PCI Slots
- ▲ Fast PCI/IDE Controller
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ 6 Drive Bays
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.1, Mouse
- ▲ Serial Ports-16550 UART
- ▲ Parallel Port-ECP/EPP
- ▲ 200 Watt Power Supply
- ▲ One-Year IBM Onsite Service

5 DP90PCI \$2999 Business Lease: \$106/Month

- ▲ Intel 90MHz Pentium CPU
- ▲ 64-bit CPU-Memory-Cache Data Path
- ▲ 256KB L2 and 16KB L1 Cache
- ▲ 8MB RAM, Max: 128MB
- ▲ 720MB IDE Hard Disk Drive
- ▲ 14" SVGA Color Monitor-LR
- ▲ Phantom 32P PCI Graphics Accelerator 2MB
- ▲ Double-Speed Multisession CD-ROM Drive
- ▲ 4 ISA, 2 PCI and 1 ISA/PCI Slots
- ▲ Fast PCI/IDE Controller
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ 6 Drive Bays
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.1, Mouse
- ▲ Serial Ports-16550 UART
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- ▲ 16MB RAM
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- ▲ Borland Office on CD-ROM
- ▲ Productivity Pack
- ▲ Order Code: DGBP02WF

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- ▲ Multimedia Upgrade Add \$90
- ▲ Mini-Tower Upgrade Add \$75
- ▲ PCI/SCSI Adapter \$325
- ▲ 1GB Fast SCSI-2 Hard Disk Drive \$799
- ▲ 2GB Fast SCSI-2 Hard Disk Drive \$1399
- ▲ 14.4 kbps Fax/Modem Internal \$142
- ▲ Matrox MGA II+, 2MB VRAM \$599
- ▲ 17" FST-NI Color Monitor \$699

WinMarks (4.0)			
	Phantom 32P	Diamond Viper	Matrox MGA II+
DP60PCI	17.7	19.7	25.9
DP90PCI	23.2	24.2	32.1



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- ▲ Windows™ 3.1
- ▲ Mouse
- ▲ One-Year IBM® Onsite Service

486 SYSTEMS

486SX/33MHz, Desktop **\$1369**

- Model D433SXA*
Business Lease: \$48/Month
- ▲ 128KB L2 Cache, Max: 256KB
 - ▲ 4MB RAM, Max: 36MB
 - ▲ 270MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ VESA® Local Bus Graphics Accelerator 1MB
 - ▲ VESA Local Bus IDE Hard Drive Controller
 - ▲ 5 ISA Slots & 5 Drive Bays

486DX2/66MHz, Desktop **\$1519**

- Model D466DXA*
Business Lease: \$54/Month
- ▲ 128KB L2 Cache, Max: 256KB
 - ▲ 4MB RAM, Max: 36MB
 - ▲ 270MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ VESA Local Bus Graphics Accelerator 1MB
 - ▲ VESA Local Bus IDE Hard Drive Controller
 - ▲ 5 ISA Slots & 5 Drive Bays

486DX2/66MHz, Desktop **\$1699**

- Model D466DXA*
Business Lease: \$60/Month
- ▲ 128KB L2 Cache, Max: 256KB
 - ▲ 8MB RAM, Max: 36MB
 - ▲ 270MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ VESA Local Bus Graphics Accelerator 1MB
 - ▲ VESA Local Bus IDE Hard Drive Controller
 - ▲ 5 ISA Slots & 5 Drive Bays

UPGRADABLE BUS MODELS

486DX2/66MHz, Desktop **\$1959**

- Model D466 I/VL*
Business Lease: \$70/Month
- ▲ 256KB L2 Cache, Write-Back
 - ▲ 8MB RAM, Max: 64MB
 - ▲ 420MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ VESA Local Bus Graphics Accelerator 1MB
 - ▲ VESA Local Bus IDE Hard Drive Controller
 - ▲ 4 16-bit ISA & 1 32-bit VL Bus Slots
 - ▲ 5 Drive Bays

100MHz Intel DX4, Desktop **\$2299**

- Model D4100 I/VL*
Business Lease: \$82/Month
- ▲ 16KB L1 & 256KB L2 Cache, Write-Back
 - ▲ 8MB RAM, Max: 64MB
 - ▲ 540MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ VESA Local Bus Graphics Accelerator 1MB
 - ▲ VESA Local Bus IDE Hard Drive Controller
 - ▲ 4 16-bit ISA & 1 32-bit VL Bus Slots
 - ▲ 5 Drive Bays

PENTIUM/PCI OR EISA

60MHz Intel Pentium, PCI **\$2599**

- Model DP60PCI*
Business Lease: \$92/Month
- ▲ 64-bit CPU-Memory-Cache Data Path
 - ▲ 256KB L2 & 16KB L1 Cache
 - ▲ 8MB RAM, Max: 128MB
 - ▲ 720MB IDE Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ PCI Graphics Accelerator 2MB
 - ▲ Double-Speed Multisession CD-ROM Drive
 - ▲ 4 ISA, 2 PCI & 1 ISA/PCI Slots
 - ▲ Fast PCI/IDE Controller
 - ▲ 6 Drive Bays
 - ▲ 200 Watt Power Supply

60MHz Intel Pentium, EISA **\$2899**

- Model DP60 E/VL*
Business Lease: \$103/Month
- ▲ 64-bit CPU-Memory-Cache Data Path
 - ▲ 256KB L2 & 16KB L1 Cache
 - ▲ 8MB RAM, Max: 64MB
 - ▲ 6 EISA & 2 EISA/VESA Slots
 - ▲ 540MB SCSI Hard Disk Drive
 - ▲ 14" SVGA Color Monitor-LR
 - ▲ Integrated SCSI-2 Controller
 - ▲ VESA Graphics, 2MB VRAM
 - ▲ 6 Drive Bays



InfoWorld, April 4, 1994

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From A 14" To A 15" FST Monitor
On Select Models.¹**



MOBILE SYSTEMS

486SX/25MHz **\$1799**

- Subnotebook Model SN425C-170*
Business Lease: \$64/Month
- ▲ 7.8" Color STN Display
 - ▲ 170MB Removable Hard Drive
 - ▲ 4MB RAM, Max: 20MB
 - ▲ External 3.5" Diskette Drive
 - ▲ 1 Type II PCMCIA Slot
 - ▲ 86-Key Keyboard
 - ▲ Integrated 16mm Trackball
 - ▲ MS-DOS 6.2, Windows 3.1
 - ▲ 4 Pounds, Including Battery
 - ▲ Borland Office™ (WordPerfect, Quattro® Pro and Paradox®)
 - ▲ Borland Sidekick
 - ▲ Monochrome Models from \$1199

486SX/33MHz **\$1999**

- Notebook Model N433C-120*
Business Lease: \$71/Month
- ▲ 9.5" Dual Scan Color Display
 - ▲ 4MB RAM, Max: 12MB
 - ▲ 120MB Hard Disk Drive
 - ▲ 3.5" Diskette Drive
 - ▲ 1 Type III PCMCIA Slot
 - ▲ 86-Key Keyboard
 - ▲ Integrated 16mm Trackball
 - ▲ MS-DOS 6.2, Windows 3.1
 - ▲ Carrying Case
 - ▲ 6.6 Pounds, Including Battery
 - ▲ Borland Office (WordPerfect, Quattro Pro and Paradox)
 - ▲ Borland Sidekick

486DX2/50MHz **\$3599**

- Notebook Model N450T-200*
Business Lease: \$128/Month
- ▲ 9.5" Active Matrix TFT Color Display
 - ▲ 8MB RAM, Max: 12MB
 - ▲ 200MB Hard Disk Drive
 - ▲ 3.5" Diskette Drive
 - ▲ 1 Type III PCMCIA Slot
 - ▲ 86-Key Keyboard
 - ▲ Integrated 16mm Trackball
 - ▲ MS-DOS 6.2, Windows 3.1
 - ▲ Carrying Case
 - ▲ 6.6 Pounds, Including Battery

Subnotebook Accessories **Road Warrior: \$376**

- ▲ PCMCIA 2.4/9.6 kbps Data/Fax Modem, Carrying Case
 - ▲ Extra Battery, Battery Charger
- Quick Dock: \$404**
- ▲ Port Replicator, Keyboard
 - ▲ 14" SVGA Color Monitor

Notebook Accessories **Instant Office: \$927**

- ▲ Docking Station, Keyboard
 - ▲ 15" FST-NI Color Monitor
- Traveler: \$278**
- ▲ PCMCIA 2.4/9.6 kbps Data/Fax Modem, Extra Battery

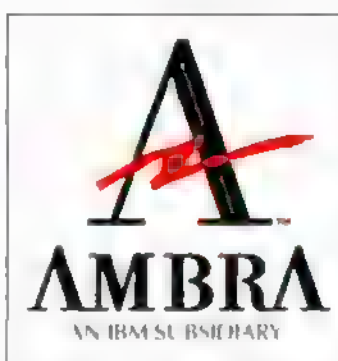


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Picks and Pans

The Best and Worst of the Notebook World



▲ Displays

Notebooks are shrinking, but displays are growing. Check out the over 10-inch displays on the Gateway ColorBook and IBM ThinkPad 755C.



◀ Mini CD-Rom Drive

So advanced, its standard hasn't been adopted by anyone. This is a new and innovative technology, but the usefulness of the 3.5-inch mini CD-ROM drive is crippled by the fact that there are few, if any, applications written for it. Watch out later this year for notebooks with full-size CD-ROM drives integrated under the keyboard.



▲ Thick and Thin

Active color or pen technology increases notebook width, but the Sharp PC-8650T is thinner than the HyperData HB320PEN.



▲ Key Size

Hitting two keys at the same time is annoying. The Sharp PC-8650T's large keys won't improve your typing but will lower your frustration.



▲ Standard Batteries

Standard batteries may be the next wave of the future. Though they have a short life, standard batteries will be lighter and easily available.



▲ Outlet Plugs

The power adapter for the TI TravelMate 4000M fits easily inside a suit jacket pocket or a purse. Duracom's adapter really is a power brick; IBM integrates the adapter into the plug. Toshiba's two-prong plug uses a standard cord connector available from almost any hardware store.



▲ Minimal PC

This \$239 diskless laptop is light and affordable, on the downside, it has a low quality screen and limited storage potential.

We received three notebooks from Broadax and one from FutureTech. All four are powered by DX2/66 CPUs and are built around the same core components. They differ only in their vendors' choice of screen technology and hard disk.



► FACT FILE

BSI NP846 Mono

List price (tested configuration): \$2,685 **Configuration:** Intel 486DX2/66, 8MB RAM, Toshiba 524MB IDE hard disk with 32K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM, \$215, 16MB RAM, \$870; docking station, \$465; automobile adapter, \$40, Xircom LAN PCMCIA card, \$225

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

BSI NP846D

List price (tested configuration): \$3,195 **Configuration:** Intel 486DX2/66, 8MB RAM, Toshiba 524MB IDE hard disk with 32K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM, \$215, 16MB RAM, \$870; docking station, \$465, automobile adapter, \$40, Xircom LAN PCMCIA card, \$225

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **GOOD**

BSI NP846T

List price (tested configuration): \$4,250 **Configuration:** Intel 486DX2/66, 8MB RAM, Toshiba 512MB IDE hard disk with 32K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM, \$215; 16MB RAM, \$870; docking station, \$465, automobile adapter, \$40, Xircom LAN PCMCIA card, \$225.

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **POOR**

Broadax Systems Inc.,
9440 Teister Ave., #4, El
Monte, CA 91731; 800-
872-4547, 818-442-0020;
fax, 818-442-4527.

479 on reader service card

Broadax's lineup includes the \$2,685 BSI NP846 Mono, the \$3,195 dual-scan passive color BSI NP846D, and the \$4,250 active-matrix color BSI NP846T. FutureTech's entry is the \$3,599 active color FutureTech FutureMate 462nV.

Each unit's display is testimony to its particular technology: Both active color systems (one from each vendor) produce bright, clear images; Broadax's dual-scan system offers a competent, lower-priced alternative to the active color unit. Broadax's monochrome system, however, produces a low-quality image: The cursor disappears rather easily, and quite a bit of ghosting occurs while one is typing.

All four units are packaged in identical cases, which feature myriad system status lights—including separate lights to indicate whether your battery is "full" or "low." Each case also sports a built-in trackball on the right side just above the keyboard, which proves to be serviceable. The keyboard is generally solid and has a good feel.

On the power front, these systems show their age. Each uses a large power adapter (about a third more bulky than many other tested units' adapters) and nickel cadmium batteries. On our battery tests, these units did not fare very well: Their ZDigit times of approximately 2 hours 15 minutes were bested by those of the majority of units in their processor class. Each unit's CMOS-based power management features are user-adjustable and feature separate auto-sleep settings for the hard disk and display.

The Broadax and FutureTech systems performed poorly on our benchmark tests. All four systems produced below-average scores on all of our tests, with the exception of Broadax's active color unit, which posted average video and disk scores. None of the units seemed to benefit much from their VL-Bus-based video and disk controllers.

On a positive note, both vendors include excellent system manuals with their units; each manual is very clearly written, is easy to use, and covers basically all that you need to know to operate your notebook—including how to install a serial or parallel device, how to hook up an external monitor, and even how to configure a PCMCIA card. Each also illustrates how to perform system



► FACT FILE

FutureTech FutureMate 462nV

List price (tested configuration): \$3,599

Configuration: Intel 486DX2/66, 8MB RAM, Toshiba 340MB IDE hard disk with 64K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.21, Microsoft Windows 3.11

Options: 16MB RAM, \$895, 520MB hard disk, \$325, docking station, \$495, PCMCIA LAN adapter, \$219.

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **POOR**

FutureTech Systems Inc.,
Six Bridge St., Hacken-
sack, NJ 07601, 800-
275-4414, 201-488-4414;
fax, 201-488-4405

479 on reader service card

upgrades—including memory and hard disk upgrades.

We have difficulty recommending any one of these systems because there are other units reviewed here that offer much better performance and features at comparable or lower prices.—Carol A. Venezia

Compaq Computer Corp.

• Compaq Contura Aero 4/25 Model 84

• Compaq Contura Aero 4/33C Model 170

The two reviewed systems in Compaq Computer Corp.'s Contura Aero line are light and compact with impressive battery lives that come at the expense of performance. Compaq skimps on CPU power with the Aeros, outfitting each with an SL-enhanced 486SXJ chip—a 486SX variant with a 16-bit external interface.

These systems are among the featherweights of the pack: The \$2,167 486SX/25-based Compaq Contura Aero 4/25 Model 84 boasts a travel weight of 5 pounds 3 ounces. Its 33-MHz cousin, the \$2,967 Compaq Contura Aero 4/33C



▶ FACT FILE

Compaq Contura Aero 4/25 Model 84

List price (tested configuration): \$2,167 Configuration: Intel 486SX/25 SL, 8MB RAM, 84MB Compaq IDE

hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1

Options: Automobile adapter, \$39; Compaq mouse, \$36; mobile port expander, \$39.

SUITABILITY TO TASK

DOS applications **POOR**

Windows applications **POOR**

Desktop replacement **FAIR**

Road warrior **GOOD**

Compaq Contura Aero 4/33C Model 170

List price (tested configuration): \$2,967 Configuration: Intel 486SX/33 SL, 8MB RAM, 170MB Compaq

IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft

Windows 3.1. Options: Automobile adapter, \$39; Compaq mouse, \$36; mobile port expander \$39

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Desktop replacement **EXCELLENT**

VENDOR SERVICE & RELIABILITY

Reliability **Above AVERAGE**

Repair service **Above AVERAGE**

Technical support **Above AVERAGE**

Compaq Computer Corp., 20555 S.H. 249, Houston, TX 77070, 800-345-1518, 713-378-8820, fax, 713-378-1442

on reader service card

Model 170 weighs in at 5 pounds 6 ounces. Using standard-size Duracell nickel hydride batteries, both systems did very well on our battery tests—testimony, perhaps, to the efficiency of their power management schemes. The monochrome Aero 4/25 lasted 7 hours 40 minutes; the color Aero 4/33C lasted for 6 hours 28 minutes.

These machines sport the same exterior design, which features a small but responsive trackball that is built into the bottom-right corner of the keyboard. Each unit offers a passive-matrix display that mea-

sures about 8 inches diagonally, which can seem small.

During testing, both Compaq units fell prey to the shortcomings of their CPUs. The Compaq Aero 4/25 ranked in the bottom ten on every test, showing especially disappointing performance on our video tests. The unit's DOSmark score was the lowest in this roundup, while its Winstone score was fourth from the bottom. The

Compaq Aero 4/33C's 33-MHz CPU provided only a slight performance lift. This system ranked fifth to last on our Graphics WinMark tests and second to last on our DOS video test suite. On our Winstone test, its score was also unimpressive.

Despite their nifty design and excellent battery lives, these units are not suited for the power-hungry user.—Michele Pepe

■ A New Generation of Apple PowerBooks

When the first Macintosh PowerBooks became a hit with Windows users, nobody was more surprised than Apple Computer. Apple is hoping for another hit with its latest PowerBooks and PowerBook Duos.

The new models use the Motorola 68LC040 CPU, but will be upgradable to a PowerPC CPU. The PowerBook 500s can hold up to 36MB of RAM;

the PowerBook Duo 280s max out at 40MB. The 500-series models employ 16-bit, CD-quality sound and have a pair of speakers in the screen. An Ethernet port is included. Screen size is

9.5 inches diagonal for the 500-series models, and hard disks range from 160MB to 320MB. All PowerBooks can be upgraded to active color (standard on the 540c), but the standard screens are: active gray-scale on the 540, dual-scan color on the 520c, and passive gray-scale on the 520.

TOUGH OF A FINGER

The trackball has been replaced with an innovative, solid-state trackpad that operates by light finger pressure. It's an impressive advance that is certain to be copied. The keyboard size is now on a par with a standard desktop unit.

The PowerBook 540 and 540c use twin nickel hydride batteries that

together can yield as much as seven hours of use. Each battery has a sensor that relays power data to the system, and battery swaps can now be made on the fly. However, the new batteries are heavy (just under a pound each) and expensive (\$139). When both were plugged in, our PowerBook 540c weighed over 7 pounds. With the power adapter and

cords, travel weight rose to over 8 pounds. An optional PowerBook PCMCIA Expansion Module plugs into the left battery bay.

A new Control Strip status bar at the bottom of the



screen can be customized to show speaker volume, as well as battery and disk drive status. Included with these units is an arsenal of useful software utilities, such as Apple Remote Access Client 2.0 and Macintosh PC Exchange 1.0.2 (to read and write to disks formatted for DOS and Windows).

While it has a price tag that can top \$5,000, the PowerBook 540c is a powerful system that can more than hold its own against any Windows notebook.—Peter Lewis

▶ **PowerBook 540c.** List price (tested configuration): \$4,839. Apple Computer Inc., 1 Infinite Loop, Cupertino, CA 95014; 800-776-2333.

Circle 471 on reader service card

This is a business software program



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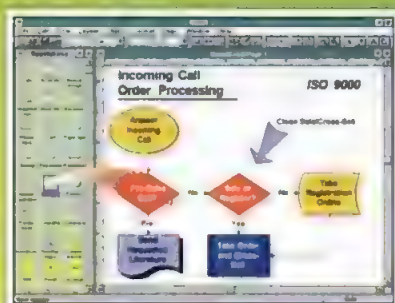
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Business graphics

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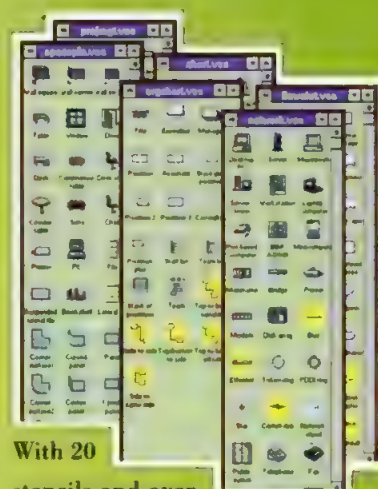
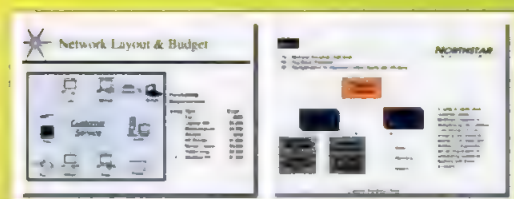


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Compaq Computer Corp.

- **Compaq Contura 4/25 Model 120**
- **Compaq Contura 4/25C Model 120**
- **Compaq Contura 4/25CX Model 120**

Compaq's Contura line of notebook PCs shows that a value-priced notebook need not sacrifice usability and battery life.

The Contura line is well designed and relatively lightweight compared with other systems in this roundup. Each unit uses an SL-enhanced 486DX/25 processor; higher-powered CPUs are not available. The monochrome Contura 4/25 is priced at \$2,474, but for \$350 more you can get the dual-scan color Contura 4/25C. The Contura 4/25CX costs \$4,055 but gives you active-matrix color and a built-in trackball—a feature that is not available on the older monochrome and dual-scan designs.

Each Contura has a 9.5-inch screen and uses the same CPU. If you're set on buying a Contura, the smart thing to do would be to purchase the Contura 4/25C and add more system memory or a bigger hard disk, thereby adding performance to color for a well-rounded system.

The Conturas' scores on our benchmark tests mirrored one another, lagging slightly behind those of the 25-MHz processor competition. The units' Winstone scores were average, as were their Disk and Graphics WinMark scores. Their performance on our DOS-based tests was generally poor: Processor and DOSmark results were slightly below average. All three systems placed near the bottom of the test group on the DOS disk test. On the DOS video test, the Contura 4/25 and Contura 4/25C's scores were among the lowest of the group; the 4/25CX's score was slightly higher than those of its siblings.

The one high point in these systems' performance is their battery life. On our battery tests, the two color units ran for over 3.5 hours and the monochrome unit ran for 4 hours 20 minutes.

Given the competition presented here, it is hard to recommend any one of the members of the Contura line. For instance,



▶ FACT FILE

Compaq Contura 4/25 Model 120

List price (tested configuration): \$2,474
Configuration: Intel 486DX/25 SL, 8MB RAM, Compaq 120MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps fax modem, clip-on trackball, DOS 6.2, Microsoft Windows 3.1
Options: Enhanced options slot adapter, \$12; Compaq SpeedPaq 14,400-bps cellular modem, \$549

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

Compaq Contura 4/25C Model 120

List price (tested configuration): \$2,824
Configuration: Intel 486DX/25 SL, 8MB RAM, Compaq 120MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps fax modem, clip-on trackball, DOS 6.2, Microsoft Windows 3.1
Options: Enhanced options slot adapter, \$12; Compaq SpeedPaq 14,400-bps cellular modem, \$549

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

Compaq Contura 4/25CX Model 120

List price (tested configuration): \$4,055
Configuration: Intel 486DX/25 SL, 8MB RAM, Compaq 120MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1
Options: Enhanced options slot adapter, \$12; Compaq SpeedPaq 14,400-bps cellular modem, \$549

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **ABOVE AVERAGE**

Technical support **ABOVE AVERAGE**

Compaq Computer Corp., 20555 S.H. 249, Houston, TX 77070, 800-345-1518, 713-378-8820, fax, 713-378-1442
 476 on reader service card

Texas Instruments is selling a comparably equipped 25-MHz active-matrix color system that eclipses the Conturas in performance and is priced significantly lower than the Contura 4/25CX.—WPF

Digital Equipment Corp.

- **DECpc 425SE**
- **DECpc 425SE Color**

Impressive price tags aside, these 25-MHz notebooks from Digital Equipment Corp. are no match for most of the competition. At \$1,763 for the monochrome DECpc 425SE and \$2,513 for the dual-scan passive DECpc 425SE Color, these systems—which are made by AST Research—are affordable, quality notebooks best suited for those users who don't require stellar performance.

Performance results were in the cellar. Among the 70 notebooks in this roundup, these systems tied each other for last place on our Winstone and processor tests and posted DOSmark scores that ranked second to last. The monochrome DECpc 425SE also finished last on our Disk WinMark and DOS disk tests. These categories were sore spots for the DECpc 425SE Color, too; it finished second to last on our Disk WinMark tests and in the bottom 15 percent on our DOS disk tests.

Video was the only area in which the units made some performance headway. Each system's VL-Bus technology and Chips & Technologies chip set helped it achieve an average Graphics WinMark score in its processor category; DOS video scores for both were above average.

These notebooks are, however, easy to upgrade; a removable panel on the bottom of each unit exposes a flash BIOS chip and the RAM modules. These features will simplify the upgrades you will most likely make to these systems in your pursuit of better performance. Each Digital notebook also lets you trickle-charge the battery so that when the battery expires (after 2 hours for the color system and nearly 3 hours for the monochrome unit), you can still use the system while recharging.

If you are determined to buy one of these modestly priced units and don't mind contending with somewhat lackluster performance, you probably won't be disappointed with the three-year warranty and the service you receive.—Jodi L. Wynblatt



► FACT FILE

DECpc 425SE

List price: \$1,763. Configuration: Intel 486SX/25, 8MB RAM, 128MB Seagate IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, DOS 6.0, Microsoft Windows 3.1, integrated trackball.
Options: 4MB RAM, \$214; 16MB RAM, \$1,899; PCMCIA cards, \$249-\$289; car adapter, \$76; carrying case, \$59.

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **POOR**

Desktop replacement **GOOD**

Road warrior **FAIR**

DECpc 425SE Color

List price: \$2,513. Configuration: Intel 486SX/25, 8MB RAM, 128MB Seagate IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.0, Microsoft Windows 3.1.
Options: 4MB RAM, \$214; 16MB RAM, \$1,899; PCMCIA cards, \$249-\$289; car adapter, \$76; carrying case, \$59.

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **POOR**

Desktop replacement **GOOD**

Desktop replacement **POOR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **AVERAGE**

Technical support **ABOVE AVERAGE**

Digital Equipment Corp.,
 146 Main St., Maynard,
 MA 01754-2571; 800-
 722-9332; fax, 800-524-
 5694.

467 on reader service card

Digital Equipment Corp.

• DECpc 433SLC Premium

Strong battery life does not justify the high price and below-average performance of the \$4,738 DECpc 433SLC Premium.

Although the processor has been upgraded, the system design is the same as that of the Digital units made by AST that we looked at in August of 1993 ("The Portable Puzzle"). The DECpc 433SLC's 9.5-inch active-matrix color screen offers a crisp display, the remov-

able hard disk facilitates upgrades, and there is an expansion port to hook up the optional docking station. With processor prices and system weights falling rapidly and active color becoming the rule, it is rather difficult to justify almost \$5,000 for a 33-MHz system that has a travel weight of more than 8 pounds.

The DECpc 433SLC's performance unfortunately doesn't do much to change this conclusion. The below-average processor, DOS video, and DOS disk scores contributed to a decidedly low DOSmark score. Using a Western Digital video chip set, the DECpc 433SLC posted a Graphics WinMark score that was among the lowest of the 33-MHz systems in this roundup. Disk WinMark and Winstone scores were also well below average.

This system represents the past, not the future, of Digital's notebooks. Digital has two new systems in this lineup, the DECpc 425SE and the DECpc 425SE Color, that may better indicate its future direction.—WPF



► FACT FILE

DECpc 433SLC Premium

List price (tested configuration): \$4,738. Configuration: Intel 486DX/33, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, clip-on trackball, DOS 6.2, Microsoft Windows 3.1. **Options:** 4MB RAM upgrade, \$250; docking station, \$379; docking port, \$89; AC adapter, \$79.

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **AVERAGE**

Technical support **ABOVE AVERAGE**

Digital Equipment Corp.,
 146 Main St., Maynard,
 MA 01754-2571; 800-
 722-9332; fax, 800-524-
 5694.

467 on reader service card



• DECpc Premium Docking Station

Digital's \$379 docking station looks more like a typewriter than a way to dock a notebook. It's not pretty, but it is functional and inexpensive.

The notebook is perched on a slant, and the docking station has a roller mechanism that forces the adapter to connect to the notebook. The mechanism isn't smooth and often makes a bad connection. Inside are two drive bays, each wide enough for a CD-ROM or floppy disk drive, as well as two 16-bit slots. The docking station has a built-in IDE controller if you want to add a hard disk or floppy disk drive; you can set the docking station's hard disk as the boot drive through the notebook's setup routine. The unit has one parallel, two serial, a PS/2 mouse, and an AT keyboard. It also has a connector for an external battery charger and a monitor stand.

We had problems using an external keyboard on the tested unit. The notebook froze and had to be rebooted with one keyboard and produced garbled characters with a second.

Since the notebook is on an angle, its LCD can be used as the primary display; you can also close it and use a VGA display. The notebook supports internal 640-by-480 resolution and can power both LCD and external VGA simultaneously.—CB

► DECpc Premium Docking Station.

List price: \$379. Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571; 800-722-9332; fax, 800-524-5694.

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IBM Credit Lease
\$97/month¹

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- Pentium chip upgradable
- 270MB² HD, 4MB RAM
- Desktop with 5 slots, 5 bays
- VESA local bus
- 128K L2 cache

The ValuePoint configurations listed above include an IBM Enhanced 101-Key Keyboard & Mouse, 1MB Video Memory (upgradable to 2MB), DOS & Windows preloaded and a 14V monitor.

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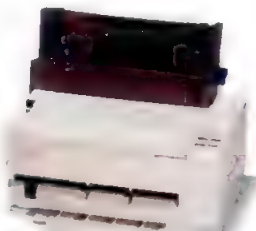
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Duracom Computer Systems

- **Duracom TravelPro NBM 486/33DX Monochrome**
- **Duracom TravelPro NBC 486/33DX Passive Color**
- **Duracom TravelPro NBAC 486/33DX Active Color**

Micro Express

- **Micro Express NB8266**
- **Micro Express NB8266M**

Duracom Computer Systems and Micro Express both sell notebook computers manufactured by Taiwan's Nan Tan Computer Co.; the differences among the systems are in their screen type, processor, and available options. The three Duracom models are equipped with Cyrix CX486DX/33 processors, and both Micro Express models have Intel 486DX2/66 CPUs.

Just a bit larger than the average notebook, these units are 2 by 11 by 8.5 inches (HWD). Travel weight ranges from 8 pounds 3 ounces to 9 pounds, which includes a battery and the bulky AC adapter. Battery life was typical for nickel cadmium-powered systems, ranging from 2.5 to 3 hours. To save power and reduce heat, the units' hardware-based power management can switch to slower system-bus and processor speeds when the CPU is not busy; LCD backlight and hard disk sleep features are also present.

This design sports a quiet 86-key keyboard with a trackball in the upper right corner and flush buttons on either side of the ball. A wrist rest in front of the keyboard slopes toward you at a greater angle than that of most designs.

An optional docking station attaches to a rear 200-pin port. Duracom sells the docking station for \$466; Micro Express's price is \$495.

Duracom's units were poor performers on most tests, in part because Duracom used a slow write-through external cache instead of a write-back cache. In fact, the average processor score for the 11 Intel DX/33 units we tested was nearly double the average score of these Cyrix-based units. All three Duracom systems came with 8MB of RAM and a 210MB hard



▶ FACT FILE

Duracom TravelPro NBM 486/33DX Monochrome

List price (tested configuration): \$2,490 Configuration: Cyrix CX486DX/33, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Duracom TravelPro NBC 486/33DX Passive Color

List price (tested configuration): \$3,074 Configuration: Cyrix CX486DX/33, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR
Road warrior	FAIR

Duracom TravelPro NBAC 486/33DX Active Color

List price (tested configuration): \$4,074 Configuration: Cyrix CX486DX/33, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.2, Microsoft Windows for Workgroups 3.11 Options: 4MB RAM upgrade, \$230, 340MB hard disk, \$580, docking station, \$466.

SUITABILITY TO TASK

DOS applications	POOR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Duracom Computer Systems, 1425 Greenway Dr., #650, Irving, TX 75038, 800-551-9000, 214-518-1200, fax, 214-518-1090

522 (in reader service card)

disk; they varied only in screen technology. The monochrome version lists for \$2,490, the dual-scan color for \$3,074, and the active-matrix color for \$4,074. Duracom sells these notebooks with a range of CPUs; a unit with an Intel 486DX2/66 processor costs \$490 more than an otherwise identical Cyrix-based model.

As expected, the Micro Express test units performed better than the Duracom models since Micro Express included a 486DX2/66 processor in both units. Micro Express's notebooks also outperformed many other 486DX2/66 machines reviewed; however, this is largely because they were the only ones with CPU cache—128K of SRAM.

The monochrome Micro Express model with 8MB of RAM and a 250MB hard disk sells for \$1,999. The active-matrix color version with a 340MB hard disk takes a big jump up to \$3,799, but this price is competitive with those of other vendors. Unlike Duracom (but typical of other vendors), Micro Express does not include on-site service; still, its 15-month warranty is slightly longer than usual.—BB



▶ FACT FILE

Micro Express NB8266M

List price (tested configuration): \$1,999 Configuration: Intel 486DX2/66, 8MB RAM, Toshiba 250MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 9,600-/2,400-bps PCMCIA fax/data

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

Options: Docking station, \$495, 14,400-bps PCMCIA fax modem, \$499

Micro Express NB8266

List price (tested configuration): \$3,799 Configuration: Intel 486DX2/66, 8MB RAM, Toshiba 340MB IDE hard disk with 256K cache; 1.44MB floppy disk drive, 9,600-/2,400-bps PCMCIA fax/data modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	POOR

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705, 800-989-9900, 714-852-1400, fax, 714-852-1225

537 (in reader service card)

DTK Computer Inc.

• DTK DCN-4T66M

• DTK DCN-4T66P

DTK Computer's DCN line of notebooks offers value-oriented technology at a reasonable price. There are no surprises here, but performance is good and all the essentials are present.

We received two units: the \$2,850 passive-color DTK DCN-4T66P and the \$2,140 monochrome DTK DCN-4T66M. Each unit has two Type II PCMCIA slots, plus room for an internal modem; each also has a built-in trackball that slides out from the front of the notebook. Available CPUs range from a 486SX/33 to a 486DX2/66; we received the latter in both



▶ FACT FILE

DTK DCN-4T66M

List price (tested configuration): \$2,140 **Configuration:** Intel 486DX2/66, 8MB RAM, Seagate 128MB IDE hard disk, 1 44MB floppy disk drive,

14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.11.

Options: 4MB RAM upgrade, \$215; 210MB removable hard disk, \$300; docking station, \$450

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **EXCELLENT**

Road warrior **FAIR**

DTK DCN-4T66P

List price (tested configuration): \$2,850

Configuration: Intel 486DX2/66 processor, 8MB RAM, Seagate 128MB IDE hard disk, 1 44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.11.

DTK Computer Inc., 770 Epperson Dr., City of Industry, CA 91748; 800-289-2385; fax, 818-810-0090

509 on reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **EXCELLENT**

Road warrior **FAIR**

▶ SUMMARY OF FEATURES

CONTINUES

Notebooks

Dealers/Direct-distribution channel Various machines are sold via mail order, through dealers, or through company-owned stores and superstores.

System weight, travel weight The system weight includes the weight of the battery. The travel weight adds that of the AC adapter brick and power cord.

Number of keys: total, function, cursor The table describes each notebook's built-in keyboard: the **total** number of keys, the number of **function** keys, and the number of **cursor** keys (including the arrow keys and the PgUp, PgDn, Home, and End keys).

Key size, distance between keys Key size is the horizontal distance across the flat top of a letter or number key. The distance between keys is determined by measuring the horizontal distance from the top edge of one key to the top edge of its neighboring key.

On-site service charge If a vendor offers on-site service for its notebooks, we list the cost of that service and the period of time that the on-site service warranty is valid. In some cases, service is included as part of the warranty. Some vendors offer free replacement of a notebook in lieu of on-site service.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced speed.

Screen type We indicate which type of screen each system has: monochrome, passive color, dual-scan passive color, or active color. Active color displays are brighter and easier to view at an angle than passive color displays; active displays provide richer colors as well. The display quality of dual-scan passive color screens is better than that of other passive color screens, but it is not as good as that offered by active color displays.

systems. Screens are available in monochrome, passive-matrix color or active-matrix color. A shortcoming is the lack of simultaneous external display capability. The removable hard disks range from 120MB to 340MB, and memory expands to a whopping 52MB.

These notebooks held their own on our benchmark tests. Their processor and Winstone scores were above average for

Video chip set manufacturer The video chip set affects the maximum external resolution and the number of simultaneous colors an external monitor can display at that resolution. Decreasing the resolution setting usually increases the maximum number of external colors.

PCMCIA slots accept removable credit card-size devices, such as modems. There are currently three standard versions: Type I, Type II, and Type III.

Modem type installed indicates the type of modem sent with the computer. We list the maximum data and fax communication speeds; all modems have send and receive capabilities.

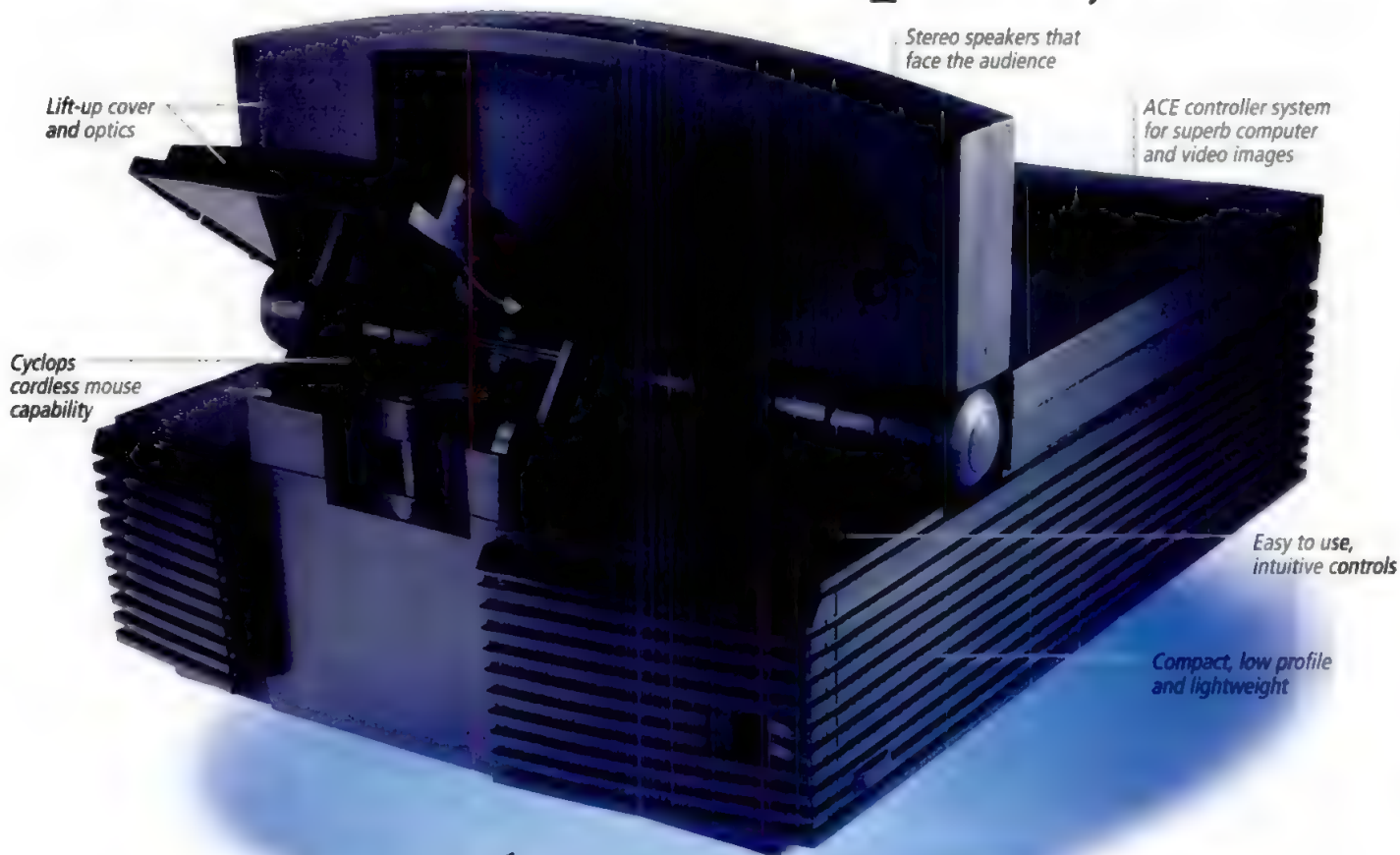
PC Magazine Labs independently tests the battery life with power-conservation features enabled, and we report the results (**Battery Life score**) here and in our benchmark test section. We also indicate the battery **charge time while on and off**, as reported by the vendor.

Battery weight, amp-hour rating We report the battery's weight in pounds and ounces. We also indicate the charge delivered by the battery in 1 hour by a current of 1 ampere.

The systems in this roundup all include power-conservation features, such as automatic **display dimming** or blanking, automatic **hard disk power-down**, slowing or halting of the **CPU**, and **peripherals power-down** for cutting off power to the I/O ports when the machine is not in use. More advanced power management features include **standby** mode (in which the system preserves its current state in memory, usually via a secondary battery) and **hibernation** (in which the system's state is written to the hard disk, ensuring that the system retains information if battery power fails).

their CPU group. Despite the fact both have the same Cirrus Logic-based video subsystem, we found that the monochrome unit outperformed the passive-matrix system on both our DOS video and Graphics WinMark tests—though the difference was small in the latter case. Compared with all tested systems, the monochrome unit's DOS video score was about average, and the color unit's score

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Desktop Projector 2800 shown above.

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► SUMMARY OF FEATURES

Notebooks

Products listed in alphabetical order

■ = YES □ = NO

	Altima Virage (active color)	Altima Virage (dual-scan color)	Ambra N75D	Ambra N100T	AMS SoundWave	AMS TravelPro 5333	AMS TravelPro 5366	Aquiline Hurricane DX2/66 Multimedia Notebook
List price (tested configuration)	\$5,055	\$3,718	\$3,448	\$5,748	\$2,895	\$2,595	\$3,895	\$4,495
Processor type and speed	Intel 486DX2/66	Intel 486DX2/66	Intel DX4/75	Intel DX4/100	Intel 486DX2/50	Intel 486DX/33	Intel 486DX2/66	Intel 486DX2/66
Hard disk capacity and interface	256MB IDE	256MB IDE	340MB IDE	455MB IDE	121MB IDE	253MB IDE	253MB IDE	340MB IDE
Dealers/Direct-distribution channel	■ ■	■ ■	□ ■	□ ■	■ ■	■ ■	■ ■	□ ■
Dimensions (HWD, in inches)	23 x 11.5 x 8.5	23 x 11.5 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	16 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	25 x 11.5 x 9.3
System weight, travel weight	6 lbs. 8 oz., 8 lbs. 3 oz.	6 lbs. 8 oz., 8 lbs. 2 oz.	6 lbs. 13 oz., 8 lbs. 2 oz.	6 lbs. 13 oz., 8 lbs. 5 oz.	5 lbs., 6 lbs. 8 oz.	6 lbs. 10 oz., 7 lbs. 13 oz.	6 lbs. 13 oz., 8 lbs. 3 oz.	7 lbs. 10 oz., 8 lbs. 6 oz.
Display area and diagonal (inches)	7.5 x 5.8 x 9.5	7.5 x 5.8 x 9.5	7.5 x 5.6 x 9.5	7.5 x 5.7 x 9.5	5.8 x 7.6 x 9.5	7.5 x 5.6 x 9.6	7.5 x 5.8 x 9.5	7.5 x 5.8 x 9.5
Number of keys: total, function, cursor	85, 12, 8	85, 12, 8	85, 12, 8	85, 12, 8	85, 10, 8	85, 12, 8	85, 10, 8	86, 12, 8
Key size, distance between keys (millimeters)	12, 6	12, 6	12, 7	12, 6	12, 5	13, 6	12, 6	13, 6
Type of pointing device installed	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball
DOS, Microsoft Windows version included	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1
Warranty	1 year	1 year	1 year	1 year	3 years	3 years	3 years	1 year
On-site service charge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	\$260.00 (1 year)
System								
Motherboard manufacturer	Philips	Phillips	Compal	Compal	AMS	AMS	AMS	Compeq
Chip set manufacturer	Pico Power	Pico Power	Pico Power	Pico Power	ACC Micro Electronics	ACC Micro Electronics/AMI	ACC Micro Electronics/AMI	OPTi
BIOS version (or date)	Phoenix (4/19/90)	Phoenix (4/19/90)	SystemSoft (8/4/93)	SystemSoft 1.00	Phoenix (4/19/90)	AMI (6/6/92)	AMI (6/6/92)	Phoenix (3/3/94)
Flash BIOS/16550 UART support	■ □	■ □	■ □	■ □	■ □	■ □	■ □	■ □
Installable system RAM	4MB–32MB	4MB–32MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–32MB	4MB–32MB	4MB–20MB
External RAM cache	None	None	None	None	None	None	None	None
Setup in ROM/Password in ROM	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Components								
Available hard disk sizes	120MB–524MB	120MB–524MB	340MB	455MB	121MB–520MB	120MB–520MB	120MB–520MB	120MB–540MB
Local-bus disk controller	□	□	□	□	■	□	□	□
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 2, 0, 1	1, 2, 0, 1	1, 2, 1, 1
High speed parallel/serial support	□ □	□ □	□ □	□ □	■ □	□ □	□ □	□ □
Screen manufacturer	NEC	Sharp	Sanyo	NEC	Hitachi	Hitachi	NEC	NEC
Screen type	Active color	Dual-scan passive color	Dual-scan passive color	Active color	Dual-scan passive color	Dual-scan passive color	Active color	Active color
Video chip set manufacturer	Western Digital	Western Digital	C&T	C&T	Western Digital	Western Digital	Western Digital	Western Digital
Video RAM	1MB	1MB	1MB	1MB	1MB	1MB	1MB	1MB
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,024 x 768
Simultaneous external display refresh rate	85-Hz	85-Hz	88-Hz	88-Hz	72-Hz	72-Hz	72-Hz	60-Hz
PCMCIA slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
Modem type installed	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	2,400-/9,600-bps PCMCIA data/fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps internal fax	14,400-bps internal fax	14,400-bps PCMCIA fax
Power								
AC adapter size (HWD, in inches)	1.5 x 5.5 x 2.3	1.5 x 5.5 x 2.3	1.4 x 5.5 x 2.8	1.4 x 5.5 x 2.8	1.6 x 2.1 x 4.5	1.5 x 3 x 5.5	1.5 x 3 x 5.5	1.5 x 2.8 x 4.5
Battery life score (hours:minutes)	1:51	2:21	4:08	2:38	2:00	2:37	2:03	3:00
Charge time while on, off (hours:minutes)	4:00, 1:30	4:00, 1:30	3:00, 1:30	3:00, 1:30	5:00, 2:00	8:00, 2:00	8:00, 2:00	10:00, 1:30
Battery weight, amp-hour rating	1 lb. 2 oz., 1.8Ah	1 lb. 2 oz., 1.8Ah	1 lb. 5 oz., 2.6Ah	1 lb. 5 oz., 2.6Ah	11 oz., 2.3Ah	1 lb. 4 oz., 2.3Ah	1 lb. 4 oz., 2.3Ah	1 lb. 8 oz., 2.3Ah
Display and hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ ■
Standby/Hibernation	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ ■

N/A—Not applicable: The product does not have this feature.

AM—American Megatrends Inc., BS—Broadcom Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc.,

FIC—First International Computer Inc., MTC—Mars Technology Corp., TI—Texas Instruments Inc., ZDS—Zenith Data Systems

Aquiline Hurricane DX4/75 Multimedia Notebook	Aquiline Hurricane DX4/100 Multimedia Notebook	ARM TS38	ARM TS38S	ARM TS38T	Aspen Select (monochrome)	Aspen Select (color)	AT&T Globalyst 200 (DX2/50)	AT&T Globalyst 200 (SX/33)	AT&T Safari 3181
\$3,995	\$4,995	\$1,797	\$2,647	\$4,197	\$2,730	\$4,655	\$4,105	\$2,700	\$4,798
Intel DX4/75	Intel DX4/100	Intel 486SX/25	Intel 486DX/33	Intel 486DX2/66	Intel 486DX/33 SL	Intel 486DX/33 SL	Intel 486DX2/50	Intel 486SX/33 SL	Intel 486DX2/50
524MB IDE	524MB IDE	128MB IDE	210MB IDE	524MB IDE	340MB IDE	524MB IDE	250MB IDE	170MB IDE	210MB IDE
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
25 x 11.5 x 9.3	25 x 11.5 x 9.3	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11.5 x 8.5	2 x 11.5 x 8.5	23 x 11.3 x 8.8	23 x 11.3 x 8.8	23 x 11.8 x 9.5
7 lbs. 10 oz.	7 lbs. 10 oz.	6 lbs. 8 oz.	6 lbs. 14 oz.	7 lbs. 3 oz.	5 lbs. 14 oz.	6 lbs. 10 oz.	6 lbs. 5 oz.	6 lbs. 2 oz.	7 lbs.
8 lbs. 11 oz.	8 lbs. 11 oz.	7 lbs. 13 oz.	8 lbs. 5 oz.	8 lbs. 6 oz.	7 lbs. 10 oz.	7 lbs. 11 oz.	7 lbs. 5 oz.	7 lbs. 2 oz.	8 lbs. 2 oz.
7.5 x 5.8 x 9.5	7.5 x 5.8 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.6 x 9.5	7.5 x 5.6 x 9.5	7.5 x 5.6 x 9.5
86, 12, 8	86, 12, 8	85, 12, 8	85, 12, 8	85, 12, 8	86, 12, 8	86, 12, 8	84, 12, 8	84, 12, 8	84, 12, 8
13, 6	13, 6	13, 6	13, 6	13, 6	12, 7	12, 7	13, 7	12, 6	13, 6
Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball
DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.11	DOS 6.2, Windows 3.1	DOS 6.21, Windows 3.11	DOS 6.2, Windows 3.1
1 year	1 year	1 year	1 year	1 year	1 year parts, 2 years labor	1 year parts, 2 years labor	3 years	3 years	3 years
\$260.00 (1 year)	\$260.00 (1 year)	N/A	N/A	N/A	N/A	N/A	Included (1 year)	Included (1 year)	Included (1 year)
Compeq OPTi	Compeq OPTi	Compal Intel	Compal Intel	Compal Intel	Featron Pico Power	Featron Pico Power	AT&T Pico Power	AT&T Pico Power	NEC Western Digital
Phoenix (3/3/94)	Phoenix (3/3/94)	SystemSoft (7/14/93)	SystemSoft (7/14/93)	SystemSoft (7/14/93)	Phoenix (4/19/90)	Phoenix (4/19/90)	Phoenix (10/9/93)	Phoenix (1/9/93)	Phoenix (1/19/93)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-32MB	4MB-32MB	4MB-20MB	4MB-20MB	4MB-20MB
None	None	None	None	None	None	None	None	None	None
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
120MB-540MB	120MB-540MB	128MB-320MB	125MB-520MB	125MB-524MB	250MB-520MB	250MB-524MB	170MB-250MB	170MB-250MB	210MB-340MB
■	■	■	■	■	■	■	■	■	■
1, 2, 1, 1	1, 2, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Sanyo Dual-scan passive color	Hitachi Active color	Sharp Monochrome	Sharp Dual-scan passive color	Toshiba Active color	Sharp Monochrome	NEC Dual-scan passive color	AT&T Active color	AT&T Dual-scan passive color	NEC Active color
Western Digital 1MB	Western Digital 1MB	C&T 1MB	C&T 1MB	C&T 1MB	Western Digital 512K-1MB	Western Digital 512K-1MB	Western Digital 1MB	Western Digital 1MB	Western Digital 1MB
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
256 colors	256 colors	64 gray shades	256 colors	256 colors	64 gray shades	256 colors	256 colors	256 colors	256 colors
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
60-Hz	60-Hz	70-Hz	70-Hz	70-Hz	60-Hz	60-Hz	72-Hz	72-Hz	72-Hz
Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type II and one Type III	Two Type II or one Type II and one Type III	Two Type II or one Type III
14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax
15 x 2.8 x 4.5	15 x 2.8 x 4.5	13 x 5.4 x 2.8	13 x 5.4 x 2.8	13 x 5.4 x 2.8	15 x 5.5 x 2.5	15 x 5.5 x 2.5	1 x 2.3 x 4.3	1 x 2.3 x 4.3	15 x 2.8 x 4.6
2.56	2.20	5.57	4.21	3.09	3.33	2.39	4.37	3.20	3.27
10:00, 1:30	10:00, 1:30	4:00, 2:00	4:00, 2:00	4:00, 2:00	4:00, 2:00	4:00, 2:00	N/A, 2:30	N/A, 2:30	2:40, 1:30
1 lb. 8 oz., 2.3Ah	1 lb. 8 oz., 2.3Ah	1 lb. 12 oz., 2.8Ah	1 lb. 11 oz., 2.8Ah	1 lb. 12 oz., 2.8Ah	1 lb. 2 oz., 1.8Ah	1 lb. 2 oz., 1.8Ah	1 lb., 2.5Ah	1 lb., 2.5Ah	1 lb. 2 oz., 3.8Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Austin DX/33 DSTN Color	Austin DX2/66 Active Matrix Color	BSI NP846 Mono	BSI NP846D	BSI NP846T	Commax Smartbook II Active Matrix	Commax Smartbook II Dual Scan	Compaq Contura Aero 4/25 Model 84
List price (tested configuration)	\$2,698	\$4,198	\$2,685	\$3,195	\$4,250	\$4,438	\$2,695	\$2,167
Processor type and speed	Intel 486DX/33 SL	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX/33	Intel 486SX/25 SL
Hard disk capacity and interface	262MB IDE	340MB IDE	524MB IDE	524MB IDE	512MB IDE	340MB IDE	252MB IDE	84MB IDE
Dealers/Direct-distribution channel	■ ■	■ ■	■ ■ ■	■ ■ ■	■ ■	■ ■	■ ■	■ ■
Dimensions (HWD, in inches)	2 x 11 x 8	2 x 11 x 8	2 x 11 x 9	2 x 11 x 9	2 x 11 x 9	2 x 11.3 x 8.5	2 x 11.3 x 8.5	1.7 x 10.3 x 7.3
System weight, travel weight	6 lbs. 10 oz., 7 lbs. 14 oz.	6 lbs. 8 oz., 7 lbs. 13 oz.	6 lbs. 3 oz., 7 lbs. 11 oz.	6 lbs. 11 oz., 8 lbs. 3 oz.	7 lbs. 11 oz., 7 lbs. 14 oz.	6 lbs. 2 oz., 7 lbs. 11 oz.	6 lbs. 2 oz., 7 lbs. 10 oz.	4 lbs. 8 oz., 5 lbs. 3 oz.
Display area and diagonal (inches)	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.8 x 9.4	7.5 x 5.8 x 9.4	7.5 x 5.8 x 9.4	7.5 x 5.6 x 9.5	7.5 x 5.6 x 9.5	6.5 x 4.8 x 8
Number of keys: total, function, cursor	85, 10, 8	85, 10, 8	86, 12, 4	86, 12, 4	86, 12, 4	86, 12, 8	86, 12, 8	78, 10, 4
Key size, distance between keys (millimeters)	12, 6	12, 6	13, 5	13, 5	13, 5	13, 6	13, 6	12, 6
Type of pointing device installed	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball
DOS, Microsoft Windows version included	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	1 year	3 years
On-site service charge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	\$115.00 (3 years)
System								
Motherboard manufacturer	Arima	Arima	BSI	BSI	BSI	Philips	Philips	Compaq
Chip set manufacturer	Intel	Intel	ETEQ	ETEQ	ETEQ	Pico Power	Pico Power	Compaq
BIOS version (or date)	Datbook BIOS (8/12/93)	AMI (6/6/92)	Award 3.2	Award 3.2-V	Award 3.2-F	Phoenix 1.03.04	Phoenix 1.03.04	Compaq (3/17/94)
Flash BIOS/16550 UART support	■ □	■ □	□ □	□ □	□ □	■ □	■ □	□ ■
Installable system RAM	4MB-32MB	4MB-32MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-32MB	4MB-32MB	4MB-12MB
External RAM cache	None	None	None	None	None	None	None	None
Setup in ROM/Password in ROM	■ ■	■ ■	■ □	■ □	■ □	■ ■	■ ■	■ □
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	□ □	■ ■
Components								
Available hard disk sizes	262MB-524MB	262MB-524MB	120MB-524MB	120MB-524MB	120MB-512MB	120MB-524MB	120MB-524MB	84MB-250MB
Local-bus disk controller	□	□	■	■	■	■	■	□
Parallel, serial, mouse, expansion ports	1, 2, 0, 1	1, 2, 0, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 0
High speed parallel/serial support	□ □	□ □	□ □	□ □	□ □	■ □	■ □	■ ■
Screen manufacturer	Sanyo	NEC	Sharp	Sanyo	Toshiba	NEC	Sanyo	Compaq
Screen type	Dual-scan passive color	Active color	Monochrome	Dual-scan passive color	Active color	Active color	Dual-scan passive color	Monochrome
Video chip set manufacturer	Western Digital	Western Digital	Cirrus Logic	Cirrus Logic	Cirrus Logic	Western Digital	Western Digital	Compaq
Video RAM	1MB	1MB	256K-512K	256K-512K	256K-512K	1MB	1MB	512K
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	256 colors	256 colors	64 gray shades	256 colors	256 colors	256 colors	256 colors	16 gray shades
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	640 x 480
Simultaneous external display refresh rate	60-Hz	60-Hz	60-Hz	60-Hz	60-Hz	70-Hz	70-Hz	N/A
PCMCIA slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	One Type II
Modem type installed	14,400-bps internal fax	14,400-bps internal fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax
Power								
AC adapter size (HWD, in inches)	1.5 x 5.3 x 3	1.5 x 5.3 x 3	2 x 6 x 3.3	2 x 6 x 3.3	2 x 6 x 3.3	1.8 x 5.5 x 2.5	1.8 x 5.5 x 2.5	1.3 x 4.6 x 2.2
Battery life score (hours:minutes)	3:27	2:09	2:15	2:08	2:09	1:39	2:58	7:40
Charge time while on, off (hours:minutes)	N/A, 1:30	N/A, 1:30	2:30, 2:30	2:30, 2:30	2:30, 2:30	1:30, 1:20	1:30, 1:20	4:00, 1:30
Battery weight, amp-hour rating	1 lb. 5 oz., 2.3Ah	1 lb. 5 oz., 2.3Ah	1 lb. 6 oz., 2Ah	1 lb. 6 oz., 2Ah	1 lb. 6 oz., 2Ah	1 lb. 2 oz., 1.8Ah	1 lb. 2 oz., 1.8Ah	1 lb., 1.5Ah
Display and hard disk power-down	■ ■	■ ■	■ ■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ ■	■ ■
Standby/Hibernation	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

N/A—Not applicable: The product does not have this feature

AMI—American Megatrends Inc., BSI—Broadax Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc.,

FIC—First International Computer Inc., MTC—Mars Technology Corp., TI—Texas Instruments Inc., ZDS—Zenith Data Systems

Compaq Contura Aero 4/33C Model 170	Compaq Contura 4/25 Model 120	Compaq Contura 4/25C Model 120	Compaq Contura 4/25CX Model 120	DECpc 425SE	DECpc 425SE Color	DECpc 433SLC Premium	DTK DCN- 4T66M	DTK DCN- 4T66P	Duracom TravelPro NBAC 406/33DX Active Color
\$2,967	\$2,474	\$2,824	\$4,055	\$1,763	\$2,513	\$4,738	\$2,140	\$2,850	\$4,074
Intel 486SX/33 St	Intel 486DX/25 St	Intel 486DX/25 St	Intel 486DX/25 St	Intel 486SX/25	Intel 486SX/25	Intel 486DX/33	Intel 486DX/266	Intel 486DX/266	Cyrix Cx486DX/33
170MB IDE	120MB IDE	120MB IDE	120MB IDE	128MB IDE	128MB IDE	210MB IDE	128MB IDE	128MB IDE	210MB IDE
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ □
12 x 10.3 x 7.3	2 x 11.5 x 8.9	2 x 11.5 x 8.9	2 x 11.5 x 8.9	1.6 x 11.5 x 8.5	1.6 x 11.5 x 8.5	2 x 11.5 x 8.5	1.9 x 11.6 x 8.7	1.9 x 11.6 x 8.7	2 x 11 x 8.5
4 lbs. 11 oz., 5 lbs. 6 oz.	6 lbs. 13 oz., 7 lbs. 14 oz.	6 lbs. 11 oz., 8 lbs. 13 oz.	6 lbs. 13 oz., 7 lbs. 14 oz.	4 lbs. 11 oz., 6 lbs. 14 oz.	6 lbs. 3 oz., 7 lbs. 6 oz.	7 lbs. 6 oz., 7 lbs. 10 oz.	6 lbs. 2 oz., 7 lbs. 14 oz.	6 lbs. 2 oz., 7 lbs. 14 oz.	8 lbs. 10 oz., 8 lbs. 8 oz.
6.2 x 4.7 x 7.8	7.6 x 5.8 x 9.5	7.5 x 5.8 x 9.5	7.6 x 5.8 x 9.5	7.5 x 5.7 x 9.4	7.5 x 5.7 x 9.4	7.5 x 5.7 x 9.5	7.5 x 5.8 x 9.5	7.5 x 5.8 x 9.5	7.5 x 5.8 x 9.5
76, 10, 4	79, 10, 4	79, 10, 4	79, 10, 4	83, 12, 6	83, 12, 6	82, 12, 8	84, 10, 8	84, 10, 8	86, 12, 4
12, 6	13, 6	12, 6	12, 6	13, 5	13, 5	12, 6	12, 6	12, 6	13, 6
Integrated trackball	Clip-on trackball	Clip-on trackball	Integrated trackball	Integrated trackball	Integrated trackball	Clip-on trackball	Integrated trackball	Integrated trackball	Integrated trackball
DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11
3 years	3 years	3 years	3 years	3 years	3 years	3 years	1 year	1 year	1 year
\$115.00 (3 years)	Included (1 year)	Included (1 year)	Included (1 year)	N/A	N/A	\$200.00 (3 years)	N/A	N/A	Included (1 year)
Compaq	Compaq	Compaq	Compaq	Quantum	Quantum	AST	DTK	DTK	Duracom
Compaq	Compaq	Compaq	Compaq	AST	Phoenix	Intel	ETEQ	ETEQ	ETP
Compaq (3/17/94)	Compaq (12/22/93)	Compaq (2/8/93)	Compaq (11/22/93)	Phoenix (11/15/93)	Phoenix (11/15/93)	AST (2/1/93)	AMI (6/6/92)	AMI (6/6/92)	Award (11/22/89)
□ ■	■ □	■ □	■ □	■ ■	■ □	■ □	□ □	□ □	■ ■
4MB-12MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-32MB	4MB-52MB	4MB-52MB	4MB-36MB
None	None	None	None	None	None	None	None	None	None
■ □	■ □	■ □	■ □	■ ■	■ □	□ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ □	■ □	□ □	■ ■	■ ■	■ ■
84MB-250MB	84MB-209MB	84MB-209MB	84MB-209MB	128MB-170MB	128MB-170MB	210MB-340MB	128MB-340MB	128MB-340MB	120MB-520MB
□	□	□	□	□	□	□	□	□	■
1, 1, 0, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 1	1, 2, 0, 1	1, 2, 0, 1	1, 1, 1, 1
■ ■	■ □	■ □	■ □	□ ■	□ □	□ □	□ □	□ □	□ ■
Compaq	Compaq	Compaq	Compaq	Sharp	Sharp	Sharp	Sharp	Sharp	Duracom
Passive color	Monochrome	Passive color	Active color	Monochrome	Dual-scan passive color	Active color	Monochrome	Passive color	Active color
Compaq	Western Digital	Compaq	Compaq	C&T	C&T	Western Digital	Cirrus Logic	Cirrus Logic	Cirrus Logic
512K	512K	512K	512K	512K	512K	512K	512K	512K	512K
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
16 colors	16 gray shades	256 colors	256 colors	256 gray shades	256 colors	256 colors	256 gray shades	256 colors	256 colors
640 x 480	800 x 600	800 x 600	800 x 600	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
N/A	125-Hz	60-Hz	70-Hz	72-Hz	72-Hz	72-Hz	56-Hz	56-Hz	74-Hz
One Type II	N/A	N/A	N/A	Two Type II or one Type III	Two Type II or one Type III	One Type II	One Type II	One Type II	Two Type II or one Type III
14,400-bps PCMCIA fax	14,400-bps internal fax	14,400-bps internal fax	14,400-bps internal fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps internal fax	14,400-bps internal fax	14,400-bps PCMCIA fax
1.3 x 4.6 x 2.2	1.5 x 3.3 x 5.3	1.5 x 3.3 x 5.3	1.5 x 3.3 x 5.3	1.8 x 3.0 x 4.5	1.8 x 3.0 x 4.5	1.5 x 4.8 x 2.8	1.5 x 6 x 2.5	1.5 x 6 x 2.5	2 x 6 x 3.3
5.2H	4.20	3.45	3.38	2.49	2.02	3.27	3.13	3.01	2.45
4.00, 2.30	1.30, 1.00	1.30, 1.00	1.30, 1.00	8.00, 2.00	8.00, 2.00	1.30, 1.00	4.30, 2.30	4.30, 2.30	3.30, 2.00
1 lb., 2.4A	1 lb. 4 oz., 2.2Ah	1 lb. 2 oz., 2.2Ah	1 lb. 4 oz., 2.2Ah	1 lb., 2.2Ah	1 lb., 2.2Ah	1 lb. 9 oz., 2.2Ah	1 lb. 7 oz., 2.3Ah	1 lb. 7 oz., 2.3Ah	1 lb. 11 oz., 2.8Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □



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► SUMMARY OF FEATURES

Products listed in alphabetical order

☐ = YES ☐ = NO

Products listed in alphabetical order									
	Duracom TravelPro NBC 486/33DX Passive color	Duracom TravelPro NBM 486DX/33 Monochrome	FutureTech FutureMate 462nV	Gateway 2000 ColorBook 486DX4-75	Gateway 2000 HandBook 486DX2-40	HyperData MB320PEN	Hyundai Neuron 400	Hyundai Neuron Lite	
List price (tested configuration)	\$3,074	\$2,490	\$3,599	\$3,748	\$2,499	\$2,950	\$1,995	\$1,895	
Processor type and speed	Cyrix Cx486DX/33	Cyrix Cx486DX/33	Intel 486DX2/66	Intel DX4/75	Intel 486DX2/40	Intel 486DX2/66	Intel 486SX/25	Intel 486SX/25	
Hard disk capacity and interface	210MB IDE	210MB IDE	340MB IDE	260MB IDE	130MB IDE	210MB IDE	170MB IDE	120MB IDE	
Dealers/Direct-distribution channel	■ □	■ □	■ ■ ■ ■ ■ ■	■ □ ■	□ ■	■ ■	■ □	■ □	
Dimensions (HWD, in inches)	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	18 x 11.5 x 8.4	16 x 9.8 x 5.9	23 x 11.5 x 8.8	18 x 11 x 8.5	15 x 10.5 x 7.8	
System weight, travel weight	6 lbs. 3 oz., 8 lbs. 5 oz	6 lbs. 10 oz., 8 lbs. 3 oz	6 lbs. 14 oz., 8 lbs. 8 oz.	5 lbs. 11 oz., 7 lbs. 3 oz.	2 lbs. 14 oz., 5 lbs. 3 oz	7 lbs. 6 oz., 9 lbs.	5 lbs. 10 oz., 6 lbs. 14 oz.	4 lbs. 3 oz., 6 lbs. 2 oz.	
Display area and diagonal (inches)	7.5 x 5.8 x 9.4	7.5 x 5.8 x 9.4	7.5 x 5.8 x 9.5	8.2 x 6.0 x 10.2	6.8 x 3.8 x 7.8	7.6 x 5.7 x 9.5	7.6 x 5.7 x 9.5	7.6 x 5.7 x 9.5	
Number of keys: total, function, cursor	86, 12, 4	86, 12, 4	86, 12, 8	85, 12, 8	78, 10, 4	85, 10, 8	84, 12, 8	84, 11, 6	
Key size, distance between keys (millimeters)	13, 6	13, 6	13, 6	12, 7	11, 6	12, 7	13, 5	13, 5	
Type of pointing device installed	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated pointing stick	Integrated trackball and pen	Integrated trackball	Integrated trackball	
DOS, Microsoft Windows version included	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Window: for Workgroups 3.11	DOS 6.21, Windows 3.11	DOS 6.21, Windows for Workgroups 3.11	DOS 6.21, Windows for Workgroups 3.11	DOS 6.2, Windows for Pen Computing 1.0	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	18 months	18 months	
On-site service charge	Included (1 year)	Included (1 year)	N/A	N/A	N/A	N/A	N/A	N/A	
System									
Motherboard manufacturer	Duracom	Duracom	MTC	Sanyo	Sanyo	HyperData	Hyundai	Hyundai	
Chip set manufacturer	OPTi	OPTi	ETEQ	Pico Power	OPTi	Symphony	OPTi	SystemSoft	
BIOS version (or date)	Award (11/22/89)	Award (11/22/89)	Award (11/22/89)	SystemSoft (4/26/94)	SystemSoft 1.01	AMI (3/21/94)	Phoenix (4/19/90)	Phoenix (4/19/90)	
Flash BIOS/16550 UART support	■ □	■ ■	■ □	■ ■	□ □	□ □	■ □	■ □	
Installable system RAM	4MB-36MB	4MB-36MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	
External RAM cache	None	None	None	None	None	None	None	None	
Setup in ROM/Password in ROM	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	
System shadowing/Video shadowing	■ ■	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	
Components									
Available hard disk sizes	120MB-520MB	120MB-520MB	170MB-520MB	120MB-260MB	130MB-130MB	130MB-520MB	120MB-250MB	120MB-170MB	
Local-bus disk controller	■	■	■	□	□	□	□	□	
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 1	1, 1, 0, 0	1, 1, 1, 0	1, 1, 1, 0	1, 2, 0, 0	1, 1, 0, 1	1, 1, 0, 0	
High speed parallel/serial support	□ □	□ ■	□ □	■ ■	□ □	■ □	□ □	□ □	
Screen manufacturer	Duracom	Duracom	Sharp	Sanyo	Sanyo	Hitachi	Sanyo	Sharp	
Screen type	Passive color	Monochrome	Active color	Dual-scan passive color	Monochrome	Dual-scan passive color	Monochrome	Monochrome	
Video chip set manufacturer	Cirrus Logic	Cirrus Logic	Cirrus Logic	Cirrus Logic	C&T	Cirrus Logic	C&T	Cirrus Logic	
Video RAM	512K	512K	512K	512K	256K	512K	512K	512K	
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	
Maximum internal gray shades or colors	256 colors	64 gray shades	256 colors	256 colors	16 gray shades	256 colors	64 gray shades	64 gray shades	
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	640 x 480	1,024 x 768	1,024 x 768	1,024 x 768	
Simultaneous external display refresh rate	74-Hz	74-Hz	60-Hz	72-Hz	N/A	72-Hz	60-Hz	60-Hz	
PCMCIA slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	One Type II	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	
Modem type installed	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	2,400-/9,600-bps PCMCIA data/fax	2,400-/9,600-bps PCMCIA data/fax	
Power									
AC adapter size (HWD, in inches)	2 x 6 x 3.3	2 x 6 x 3.3	2 x 6 x 3.3	1.6 x 2.3 x 5	1.5 x 6.3 x 2.5	1.8 x 3 x 6	1.6 x 2.4 x 5.4	1.8 x 2.5 x 5.8	
Battery life score (hours:minutes)	2:45	2:52	2:21	4:57	3:03	1:27	2:20	2:13	
Charge time while on, off (hours:minutes)	2:30, 2:00	2:30, 2:00	2:00, 2:00	N/A, 2:00	2:00, 2:00	2:00, 1:20	4:00, 2:00	4:00, 2:00	
Battery weight, amp-hour rating	1 lb. 15 oz., 2.8Ah	1 lb. 11 oz., 2.8Ah	1 lb. 6 oz., 2Ah	1 lb. 4 oz., 2.3Ah	8 oz., 2.2Ah	1 lb. 4 oz., 2Ah	15 oz., 1.7Ah	15 oz., 2.2Ah	
Display and hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
CPU/peripherals power-down	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ □	■ □	
Standby/Hibernation	■ □	■ □	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	

N/A-Not applicable The product does not have this feature

AMI—American Megatrends Inc., BSI—Broadax Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc., FIC—First International Computer Inc., MTC—Mars Technology Corp., TI—Texas Instruments Inc., ZDS—Zenith Data Systems



IBM ThinkPad 360C	IBM ThinkPad 360P	IBM ThinkPad 755C	Identity Select Series (DX/33)	Intelligent Executive EchoBook DX4-75	Intelligent Professional EchoBook DX2-50	Intelligent Value EchoBook DX-33	Micro Express NB8268	Micro Express NB8266M	Mitsuba Ninja II TS38M
\$4,339	\$4,239	\$7,389	\$3,499	\$5,345	\$3,145	\$2,345	\$3,799	\$1,999	\$1,900
Intel 486SX/33 SL	Intel 486SX/33 SL	Intel DX4/75	Intel 486DX/33 SL	Intel DX4/75	Intel 486DX2/50	Intel 486DX/33 SL	Intel 486DX2/66	Intel 486DX2/66	Intel 486SX/33
170MB IDE	327MB IDE	540MB IDE	340MB IDE	524MB IDE	340MB IDE	210MB IDE	340MB IDE	250MB IDE	120MB IDE
■ ■	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	□ ■	□ ■	■ □
2 x 11.7 x 8.3	2 x 11.7 x 8.3	2 x 11.7 x 8.3	2 x 11.5 x 8.8	1.7 x 11.2 x 8.8	1.7 x 11.2 x 8.8	1.7 x 11.2 x 8.8	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5
6 lbs. 2 oz., 6 lbs. 14 oz.	6 lbs. 13 oz., 7 lbs. 11 oz.	6 lbs. 6 oz., 7 lbs. 6 oz.	6 lbs. 10 oz., 8 lbs. 3 oz.	6 lbs. 3 oz., 7 lbs. 11 oz.	6 lbs. 2 oz., 7 lbs. 3 oz.	6 lbs., 7 lbs. 6 oz.	7 lbs. 5 oz., 9 lbs.	4 lbs. 13 oz., 8 lbs. 3 oz.	6 lbs. 13 oz., 8 lbs. 5 oz.
6.7 x 5.2 x 8.4	7.5 x 5.7 x 9.4	8.3 x 6.3 x 10.4	7.5 x 5.8 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.5	7.5 x 5.5 x 9.3	7.6 x 5.8 x 9.7	7.5 x 5.5 x 9.5
85, 12, 4	85, 12, 4	85, 12, 4	86, 12, 8	86, 12, 8	86, 12, 8	86, 12, 8	86, 12, 8	86, 12, 8	85, 12, 8
13, 7	13, 6	13, 7	12, 6	12, 5	12, 5	12, 5	13, 6	12, 1	12, 6
Integrated pointing stick	Integrated pointing stick	Integrated pointing stick	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball
IBM PC DOS 6.3, Windows 3.1	IBM PC DOS 6.3, Windows 3.1	IBM PC DOS 6.3, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11
1 year	1 year	3 years	1 year	1 year	1 year	1 year	15 months	15 months	1 year
\$40.00 (1 year)	\$40.00 (1 year)	\$40.00 (1 year)	N/A	\$259.00 (3 years)	\$229.95 (3 years)	\$199.95 (3 years)	N/A	N/A	N/A
IBM	IBM	IBM	Featron	FIC	FIC	FIC	Micro Express	Micro Express	Mitsuba
Intel	Intel	Intel	Pico Power	Pico Power	Pico Power	Pico Power	OPTi	OPTi	Pico Power
IBM (3/15/94)	IBM (3/11/94)	IBM (3/18/94)	Phoenix (4/19/90)	Phoenix 2.04	Phoenix 2.04	Phoenix (4/19/90)	Award 3.20-00kT	Award (11/22/89)	SystemSoft (7/14/93)
■ ■	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ □	■ □	■ □
4MB-20MB	4MB-20MB	4MB-36MB	4MB-32MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB
None	None	None	None	None	None	None	0-256K	0-256K	None
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□ □	□ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
170MB-540MB	170MB-340MB	170MB-540MB	130MB-525MB	120MB-524MB	120MB-524MB	120MB-524MB	200MB-340MB	200MB-340MB	120MB-520MB
■	■	■	□	□	□	□	□	□	□
1, 1, 1, 1	1, 1, 2, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
■ ■	■ ■	■ ■	□ □	■ ■	■ ■	■ ■	□ □	□ □	□ □
Sharp	Toshiba	DTI	Sanyo (or Sharp)	Toshiba	Toshiba	Toshiba	Toshiba	Toshiba	Sharp
Active color	Dual-scan passive color	Active color	Dual-scan passive color	Active color	Dual-scan passive color	Monochrome	Active color	Monochrome	Monochrome
Western Digital	Western Digital	Western Digital	Western Digital	Western Digital	Western Digital	Western Digital	Cirrus Logic	Cirrus Logic	C&T
1MB	1MB	1MB	1MB	1MB	1MB	1MB	1MB	1MB	512K
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
256 colors	256 colors	256 colors	256 colors	256 colors	256 colors	64 gray shades	256 colors	64 gray shades	64 gray shades
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	800 x 600
60-Hz	60-Hz	60-Hz	65-Hz	72-Hz	72-Hz	72-Hz	60-Hz	60-Hz	60-Hz
Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
2,400-/9,600-bps PCMCIA data/fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-/9,600-bps PCMCIA data/fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	2,400-/9,600-bps PCMCIA data/fax	2,400-/9,600-bps PCMCIA data/fax	14,400-/9,600-bps PCMCIA data/fax
1.3 x 2.3 x 5.2	1.3 x 2.3 x 5.2	1.3 x 2.5 x 5	1.8 x 5.8 x 2.5	1.6 x 5.6 x 2.5	1.6 x 5.6 x 2.5	1.6 x 5.6 x 2.5	2 x 6 x 3.3	2 x 6 x 3.3	1.3 x 5.3 x 2.5
5.40	4.46	5.09	2.51	1.49	2.37	3.02	2.38	2.50	5.16
2:00, 1:30	2:00, 1:00	2:00, 1:30	2:00, 2:00	2:00, 1:00	2:00, 1:00	2:00, 1:00	2:00, 1:30	2:00, 1:30	4:00, 2:30
1 lb 3 oz., 3.3Ah	1 lb 3 oz., 2.9Ah	1 lb 4 oz., 3.3Ah	1 lb 2 oz., 1.8Ah	1 lb 4 oz., 2.4Ah	1 lb 4 oz., 2.4Ah	1 lb 4 oz., 2.4Ah	1 lb 11 oz., 2.8Ah	1 lb 11 oz., 2.8Ah	1 lb 12 oz., 2.8Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	□ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ ■

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SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Mitsuba Ninja II TS38S	MPC Model 380 (dual- scan color)	MPC Model 380 (monochrome)	NEC Versa E Series DX4/75	Panasonic CF-V21P	Sharp PC- 8150T	Sharp PC- 8650T
List price (tested configuration)	\$2,995	\$2,717	\$2,197	\$6,367	\$4,999	\$3,423	\$3,723
Processor type and speed	Intel 486DX2/66 SL	Intel 486DX2/66	Intel 486DX2/50	Intel DX4/75	Intel 486DX2/50	Intel 486DX/33 SL	Intel 486DX/33 SL
Hard disk capacity and interface	340MB IDE	210MB IDE	340MB IDE	340MB IDE	210MB IDE	213MB IDE	213MB IDE
Dealers/Direct-distribution channel	■ □	■ ■	■ ■	■ ■	■ □	■ □	■ □
Dimensions (HWD, in inches)	2 x 11 x 8.5	1.9 x 11 x 8.5	1.9 x 11 x 8.5	2.3 x 11.8 x 9.3	2.5 x 11.6 x 8.5	1.8 x 11.3 x 8.8	1.8 x 11.3 x 8.8
System weight, travel weight	6 lbs. 14 oz., 8 lbs. 6 oz.	6 lbs. 14 oz., 8 lbs. 5 oz.	6 lbs. 5 oz., 7 lbs. 11 oz.	6 lbs. 14 oz., 8 lbs. 2 oz.	6 lbs. 6 oz., 8 lbs. 3 oz.	6 lbs. 11 oz., 7 lbs. 14 oz.	6 lbs. 8 oz., 7 lbs. 14 oz.
Display area and diagonal (inches)	8.5 x 6.3 x 10.5	8.3 x 5.9 x 10.3	7.5 x 5.6 x 9.4	7.5 x 5.8 x 9.5	8.4 x 6.4 x 10.5	7.5 x 5.8 x 9.5	6.8 x 5.1 x 8.5
Number of keys: total, function, cursor	85, 12, 8	85, 12, 8	85, 12, 8	83, 12, 8	84, 12, 6	85, 12, 8	85, 12, 8
Key size, distance between keys (millimeters)	12, 6	13, 7	12, 7	12, 6	12, 7	14, 5	14, 4
Type of pointing device installed	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Integrated trackball	Snap-on trackball	Snap-on trackball
DOS, Microsoft Windows version included	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.0, Windows 3.1
Warranty	1 year	1 year	1 year	3 years	1 year	1 year	1 year
On-site service charge	N/A	N/A	N/A	N/A	N/A	N/A	N/A
System							
Motherboard manufacturer	Mitsuba	MPC Technologies	MPC Technologies	NEC	Panasonic	Sharp	Sharp
Chip set manufacturer	Pico Power	Pico Power	Pico Power	Western Digital	Intel	Sharp	Sharp
BIOS version (or date)	SystemSoft (7/14/93)	SystemSoft (12/18/93)	SystemSoft (12/18/93)	Phoenix (1/19/93)	IBM (1/28/94)	Phoenix (4/19/90)	Phoenix (4/19/90)
Flash BIOS/16550 UART support	■ □	■ □	■ □	■ □	■ □	■ □	■ □
Installable system RAM	4MB-20MB	4MB-20MB	4MB-20MB	4MB-36MB	4MB-20MB	4MB-20MB	4MB-20MB
External RAM cache	None	None	None	None	None	None	None
Setup in ROM/Password in ROM	■ ■	■ □	■ ■	■ ■	■ ■	■ ■	■ ■
System shadowing/Video shadowing	■ ■	■ □	■ ■	■ ■	■ ■	■ □	■ □
Components							
Available hard disk sizes	120MB-520MB	120MB-524MB	120MB-524MB	209MB-528MB	210MB-450MB	213MB	213MB
Local-bus disk controller	□	□	□	□	□	□	□
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
High speed parallel/serial support	□ □	□ □	■ □	□ □	□ □	■ □	□ □
Screen manufacturer	Sharp	Sharp	Epson	NEC	Panasonic	Sharp	Sharp
Screen type	Dual-scan passive color	Dual-scan passive color	Monochrome	Active color	Active color	Dual-scan passive color	Active color
Video chip set manufacturer	C&T	C&T	C&T	Western Digital	Western Digital	Cirrus Logic	Cirrus Logic
Video RAM	512K	512K	512K	1MB	1MB	512K	512K
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	256 colors	256 colors	64 gray shades	256 colors	256 colors	256 colors	256 colors
Maximum external resolution	800 x 600	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Simultaneous external display refresh rate	60-Hz	60-Hz	60-Hz	60-Hz	60-Hz	N/A	N/A
PCMCIA slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	One Type II	One Type II
Modem type installed	14,400-/9,600-bps PCMCIA data/fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	14,400-bps internal fax	14,400-bps internal fax
Power							
AC adapter size (HWD, in inches)	1.3 x 5.3 x 2.5	1.3 x 5.4 x 2.8	1.3 x 5.4 x 2.8	1.3 x 4.5 x 2.5	1.0 x 2.8 x 5.5	1.3 x 5.8 x 2.7	1.3 x 5.8 x 2.7
Battery life score (hours:minutes)	3:15	3:39	4:27	2:39	2:32	2:52	3:32
Charge time while on, off (hours:minutes)	4:00, 2:30	4:00, 2:30	4:00, 2:30	2:18, 1:20	5:00, 2:00	N/A, 2:00	N/A, 2:00
Battery weight, amp-hour rating	1 lb. 12 oz., 2.8Ah	1 lb. 12 oz., 2.8Ah	1 lb. 12 oz., 2.8Ah	1 lb. 2 oz., 3.8Ah	12 oz., 1.8Ah	1 lb. 8 oz., 2.3Ah	1 lb. 8 oz., 2.3Ah
Display and hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ □
Standby/Hibernation	□ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

N/A—Not applicable: The product does not have this feature.

AMI—American Megatrends Inc., BSI—Broadcom Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc.,
FIC—First International Computer Inc., MTC—Mars Technology Corp., TI—Texas Instruments Inc., ZDS—Zenith Data Systems



TI TravelMate 4000E WinDX2/50 DSC	TI TravelMate 4000E WinDX2/50 Monochrome	TI TravelMate 4000M	Toshiba Satellite T1910	Toshiba T4700CS	Toshiba T4800CT	Twinhead Slimnote 486E 4DX2/65T	WinBook XP DX2/50 4/280 Monochrome	ZDS Z-Lite 425L
\$3,299	\$2,899	\$3,799	\$1,900 (estimated)	\$3,918	\$6,868	\$4,827	\$2,098 (estimated)	\$1,799
Intel 486DX2/50	Intel 486DX2/50	Intel 486SX/33	Intel 486SX/33	Intel 486DX2/50	Intel DX4/75	Intel 486DX2/66	Intel 486DX2/50	Intel 486SX/25 SL
210MB IDE	210MB IDE	210MB IDE	130MB IDE	213MB IDE	524MB IDE	340MB IDE	260MB IDE	172MB IDE
■ ■	■ ■	■ ■	■ □	■ □	■ □	■ ■	■ ■	■ ■
2.3 x 11 x 8.5	1.8 x 11 x 8.5	2 x 11 x 8.5	2 x 11.5 x 8.3	2 x 11.5 x 8	2 x 11.5 x 8	1.9 x 11.3 x 8.8	2 x 11.5 x 8.5	1.5 x 9.9 x 9.5
6 lbs. 10 oz.,	6 lbs. 10 oz.,	6 lbs. 10 oz.,	6 lbs. 10 oz.,	7 lbs., 8 lbs. 2 oz.	7 lbs. 3 oz.,	6 lbs. 14 oz.,	5 lbs. 10 oz.,	4 lbs. 3 oz.,
8 lbs. 3 oz.	8 lbs. 3 oz.	7 lbs. 3 oz.	7 lbs. 8 oz.		8 lbs. 8 oz.	8 lbs. 8 oz.	6 lbs. 8 oz.	6 lbs. 8 oz.
7.5 x 5.6 x 9.4	7.9 x 5.9 x 9.8	6.8 x 5.2 x 8.5	7.6 x 5.7 x 9.4	7.5 x 5.7 x 9.3	7.5 x 5.7 x 9.3	7.5 x 6.7 x 9.3	7.5 x 5.8 x 9.5	6.8 x 5.1 x 8.5
83, 12, 8	83, 12, 8	84, 12, 8	82, 12, 8	82, 12, 8	82, 12, 8	85, 12, 8	82, 12, 8	82, 12, 8
13.6	13.6	13.6	13.7	13.6	13.6	14.5	12.6	11.6
Snap-on trackball	Snap-on trackball	Integrated pointing stick	Snap-on trackball	Snap-on trackball	Snap-on trackball	Integrated trackball	Integrated trackball	Snap-on trackball
DOS 6.2,	DOS 6.2,	DOS 6.2,	DOS 6.2,	DOS 6.2,	DOS 6.2,	DOS 6.2	DOS 6.2,	DOS 6.0,
Windows 3.1	Windows 3.1	Windows for Workgroups 3.11	Windows 3.1	Windows for Workgroups 3.11	Windows for Workgroups 3.11	Windows 3.1	Windows 3.1	Windows 3.1
1 year	1 year	1 year	1 year	3 years	3 years	1 year	1 year	1 year
\$129.00 (1 year)	\$129.00 (1 year)	\$129.00 (1 year)	\$49.95	\$49.95 (1 year)	\$49.95 (1 year)	N/A	N/A	\$35.00 (1 year)
TI	TI	TI	Toshiba	Toshiba	Toshiba	Twinhead	ASE	ZDS
TI	Cirrus Logic	TI	Toshiba	Pico Power	Toshiba	Pico Power	ACC Micro	Intel
							Electronics	
Phoenix 1.01	Phoenix 1.52	Phoenix 1.52	Toshiba 1.10 T1910	Toshiba 2.30	Toshiba 2.10	Phoenix (12/15/94)	Phoenix (4/19/90)	ZDS (7/20/93)
□ □	■ □	□ ■	■ □	■ □	■ □	■ □	■ ■	■ □
4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	8MB-24MB	8MB-24MB	4MB-20MB	4MB-32MB	4MB-20MB
None	None	None	None	None	None	None	None	None
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
210MB	210MB	210MB	120MB-200MB	200MB-320MB	524MB	200MB-500MB	120MB-520MB	120MB-172MB
□	□	□	□	■	■	□	□	□
1, 1, 2, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 0
□ □	□ □	■ ■	■ □	□ □	□ □	□ □	□ ■	■ □
Sanyo	Sharp	Sanyo	Info not available	Info not available	Info not available	NEC	Hitachi	Sanyo
Dual-scan	Monochrome	Active color	Monochrome	Dual-scan	Active color	Active color	Monochrome	Monochrome
passive color				passive color				
Cirrus Logic	Cirrus Logic	Cirrus Logic	Western Digital	Western Digital	Western Digital	Western Digital	Western Digital	C&T
1MB	1MB	1MB	256K	1MB	1MB	1MB	1MB	256K-512K
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
64 colors	64 gray shades	16 colors	256 gray shades	256 colors	256 colors	256 colors	64 gray shades	64 gray shades
1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
74-Hz	74-Hz	74-Hz	60-Hz	60-Hz	60-Hz	72-Hz	70-Hz	70-Hz
N/A	N/A	Two Type II or one Type III	One proprietary 14.5-mm slot that supports Type I, II, III, or larger cards	One Type II and one proprietary 16-mm slot that supports Type I, II, III, or larger cards	One Type II and one proprietary 16-mm slot that supports Type I, II, III, or larger cards	One Type II	Two Type II or one Type III	Two Type II or one Type III
14,400-bps internal fax	14,400-/9,600-bps internal data/fax	14,400-bps PCMCIA fax	14,400-bps PCMCIA fax	2,400-/9,600-bps PCMCIA data/fax	2,400-/9,600-bps PCMCIA data/fax	14,400-bps internal fax	14,400-bps internal fax	14,400-/9,600-bps PCMCIA data/fax
1.5 x 2.3 x 6.1	1.5 x 2.3 x 6.1	1 x 1.8 x 4	1 x 2.8 x 5.5	1.3 x 5.5 x 3	1.3 x 5.5 x 3	1.5 x 5.8 x 2.8	1.5 x 4.5 x 2	1.1 x 5.3 x 2.5
3.09	1.55	3.21	5.20	4.32	4.33	3.02	9.28	4.08
3:00, 3:00	3:00, 3:00	3:00, 3:00	N/A, 2:18	3:00, 1:30	3:00, 1:30	8:00, 2:00	5:00, 2:00	2:00, 2:00
1 lb. 5 oz., 2.7Ah	1 lb. 5 oz., 6.7Ah	1 lb. 5 oz., 2.7Ah	1 lb. 4 oz., 2.6Ah	1 lb. 4 oz., 2.6Ah	1 lb. 4 oz., 2.6Ah	1 lb. 8 oz., 1.7Ah	1 lb. 4 oz., 2.5Ah	15 oz., 2.3Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ □	■ □	■ □	■ □	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

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was below average; Graphics WinMark results were above average and average, respectively. Disk scores also differed: The monochrome unit came out ahead on our Disk WinMark and DOS disk tests. Again, overall results were about average.

The systems' nickel cadmium batteries were adequate: The monochrome unit had a battery life of 3 hours 13 minutes, while the color unit ran for about 3 hours.—*AY*

Gateway 2000 Inc.

● Gateway 2000 ColorBook DX4-75

The \$3,748 Gateway ColorBook DX4-75 is a winning combination of processing power, display quality, and long battery life in a lightweight package.

In terms of processor power, the ColorBook comes in near the top of this lineup. Only the Toshiba T4800CT bested it among the DX4/75 group, and the ColorBook placed in the top quarter overall. Winstone results were equally good overall but average compared with the stiffer competition of the DX4/75 group.



► FACT FILE

Gateway 2000 ColorBook DX4-75

List price (tested configuration): \$3,748 **Configuration:** Intel DX4/75 processor, 8MB RAM, Toshiba 260MB IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball, DOS 6.21, Microsoft Windows for Workgroups 3.11 **Options:** 9,600-/2,400-bps PCMCIA fax/data modem, \$149

Gateway 2000 Inc., 610 Gateway Dr., North Sioux City, SD 57049-2000; 800-846-2000, 605-232-2000, fax, 605-232-2023.
\$35 on reader service card

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Windows applications	GOOD
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Road warrior	FAIR

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The ColorBook fared less well under DOS-based testing, with a DOS video score in the bottom 20 percent overall and an average DOS disk score. But you won't be disappointed by its Disk WinMark score, which was well above the average.

The ColorBook uses an aggressive power-management scheme to achieve nearly five hours of battery life. The power-down settings for the hard disk, display, and CPU are individually adjustable, and Gateway also provides a predefined configuration. The only downside is the unit's lack of trickle-charging. The system's 10.2-inch dual-scan passive-matrix color screen is bright and rich.

Besides the top-of-the-line ColorBook DX4/75, Gateway offers ColorBooks with a choice of CPUs, starting with a 486SX/33 chip and a 9.5-inch screen. But Gateway makes the screen choice for you, sticking with the dual-scan color screen for all its ColorBook models.—*JLW*

Gateway 2000 Inc.

● Gateway 2000 HandBook DX2-40

Gateway 2000's \$2,499 HandBook 486DX2-40 is unique. Not only is it the only system in this roundup based on the DX2/40 CPU, but it is also the only system that combines the functionality (if not the performance) of a full-size notebook with the light weight of a subnotebook.

With a travel weight of 5.2 pounds (the system alone weighs just 2.9 pounds), the Gateway HandBook and its external floppy disk drive can both be carried easily. The only major shortcoming is the screen: The Gateway HandBook has a longer than normal screen that gives everything a squashed look; color is not an option. The unit's PCMCIA slot, built-in pointing device, and 3-hour battery life help bridge the gap between notebook and subnotebook.

On our benchmark tests, the Gateway HandBook performed like a mid-range DX/33 system. The HandBook posted below-average scores on all of the DOS-based tests when compared to the 33-MHz units in this review. The story was the same on our Windows-based tests, with the exception of the Disk WinMark tests; there, the unit scored in a range closer to



► FACT FILE

Gateway 2000 HandBook DX2-40

List price (tested configuration): \$2,499 **Configuration:** Intel 486DX2/40 SL, 8MB RAM, Areal 130MB IDE hard disk with 32K cache, 1 44MB floppy disk drive, 14,400-bps PCMCIA fax

modem, integrated pointing stick, DOS 6.21, Microsoft Windows 3.11. **Options:** 9,600-/2,400-bps PCMCIA fax/data modem, \$149; nickel hydride battery, \$89.

Gateway 2000 Inc.,

610 Gateway Dr.
North Sioux City,
SD 57049-2000;
800-846-2000, 605-
232-2000, fax, 605-232-
2023.

\$35 on reader service card

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	POOR
Road warrior	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

that of the 75-MHz systems in this lineup.

With the HandBook, Gateway has taken a big step toward a fully functional subnotebook. The next two steps seem obvious: Increase performance and add a color display.—*WPF*

HyperData Technology Corp.

● HyperData HB320PEN

The \$2,950 HyperData HB320PEN notebook offers some features not normally found on a notebook system, but its unique design is marred by other issues. Its performance was well below the average of the other 66-MHz systems in this roundup and its battery life failed to break the two-hour mark.

Some of the nice extras include pen capability, a built-in dedicated numeric keypad, a removable hard disk, and direct access to the interior of the system. There are some flaws in the design. For instance, the PCMCIA slots only allow half of the card to slide in, so the card or the slot itself

could be damaged when moving the notebook; this also prevents the user from moving the notebook when a card is loaded.

The HB320PEN proved itself a poor performer in both the DOS and Windows arenas. Its processor score was the second lowest of the 66-MHz systems, and its DOS video and Graphics WinMark scores were also among the lowest of the group. The unit came equipped with a 210MB Seagate hard disk and posted the lowest results on both the DOS disk and Disk WinMark tests; true to form, its Winstone score was also the lowest of the 66-MHz systems. But even if this machine were a real screamer, you still wouldn't get much work done on the road with a battery that lasts for only 1 hour 27 minutes.—WPF



► FACT FILE

HyperData HB320PEN

List price (tested configuration): \$2,950 **Configuration:** Intel 486DX/66, 8MB RAM, Seagate 210MB IDE hard disk, 1.44MB floppy disk drive, 14,400-bps PCMCIA fax modem, integrated trackball and pen device, DOS 6.2, Microsoft Windows for Pen Computing, 1.0.

Options: 4MB RAM upgrade, \$400; 340MB hard disk, \$200.

HyperData Technology Corp., 809 S. Lemon Ave., Walnut, CA 91789; 909-468-2950; fax, 909-468-2954

536 on reader service card

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **POOR**

Hyundai Electronics America

• Hyundai Neuron Lite

The Hyundai Neuron Lite has several positive aspects, including a good price (\$1,895) and a weight of about 6 pounds with the external floppy disk drive. But its monochrome screen and low performance may make you think twice before buying.

Our test machine had business audio



► FACT FILE

Hyundai Neuron Lite

List price (tested configuration): \$1,895 **Configuration:** Intel 486SX/25 processor, 8MB RAM, Toshiba 120MB IDE hard disk, 1.44MB floppy disk drive, 2,400/9,600-bps PCMCIA data/fax modem, integrated trackball, DOS 6.0, Microsoft Windows 3.1

Hyundai Electronics America, 166 Bay Pointe Pkwy., San Jose, CA 95134; 800-627-7978, 408-894-9710; fax, 408-894-9751.

538 on reader service card

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

built in and a 9,600/2,400-bps fax/data modem. It came with a Type III PCMCIA slot that doubles as a pair of Type II slots, a built-in (removable) trackball at the base of the keyboard, and a removable hard disk. Using the external floppy disk drive takes up one of the PCMCIA slots, however. Memory is user-upgradable to 20MB; the high-end hard disk is 170MB.

Though certainly serviceable, the 486SX/25 Neuron Lite won't be winning any performance prizes. Its disk scores under both DOS and Windows are below average, and that helped keep its DOSmark score low as well. Its Cirrus Logic chip set helped it achieve better graphics performance under Windows than under DOS: Its score on our Graphics WinMark tests was about average for its processor group, while DOS video performance was below average. Within its CPU class, the Neuron Lite's processor score was above average and its Winstone score about average. The nickel cadmium batteries lasted 2 hours 13 minutes; an extra battery is a must for long trips.

Its weight, price, and 18-month warranty may attract some, but better performance can be found in other machines.—AY

Hyundai Electronics America

• Hyundai Neuron 400

Though the 486SX/25-based Hyundai Neuron 400 has the low price of \$1,995, it has few distinguishing features, and its performance doesn't measure up to that of other units reviewed here.

This 7-pound system has a monochrome screen; dual-scan color screens will be available this fall. The model we tested came with a 486SX/25 CPU (a 486DX/33-based unit is also available). The Neuron 400's removable hard disk is not as easy to replace as some, since you have to disconnect the cable between the hard disk and the system. There's a pair of PCMCIA Type II slots that can double as a Type III slot and an expansion slot for a port replicator. The unit has a 3.5-inch floppy disk drive built in and integrates a trackball into the upper right corner.

The Neuron 400's less weighty sibling, the Neuron Lite, beat it on almost every test. The 400's DOS disk and Disk WinMark scores were both low, as were its DOS video and Graphics WinMark scores. As a result, neither its DOSmark nor its Winstone score was very good. Its proces-



► FACT FILE

Hyundai Neuron 400

List price (tested configuration): \$1,995 **Configuration:** Intel 486SX/25, 8MB RAM, Quantum 170MB IDE hard disk, 1.44MB floppy disk drive, 9,600-/2,400-bps PCMCIA fax/data modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 **Options:** 4MB RAM upgrade, \$253; nickel hydride battery, \$158.

Hyundai Electronics America, 166 Bay Pointe Pkwy., San Jose, CA 95134; 800-627-7978, 408-894-9710; fax, 408-894-9751

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SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

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sor score, however, was average within its CPU class. Its nickel cadmium battery lasted only 2 hours 19 minutes on our tests.

Though the Hyundai Neuron 400 will get the job done, there are better bargains in this roundup that offer more performance.—AY

IBM Personal Computer Co.

• IBM ThinkPad 360C

• IBM ThinkPad 360P

Aware that not everyone can find or afford its ThinkPad 755C, IBM has designed the \$4,339 ThinkPad 360C and \$4,239, pen-capable ThinkPad 360P. Both are powered by a 486SX/33 CPU and include enough features to make mobile computing bearable.

Unlike the ThinkPad 755C's sensational 10.4-inch active-matrix color display, the ThinkPad 360C's screen is 8.5 inches; the ThinkPad 360P has a 9.5-inch screen that can be turned over to use the unit's wireless pen. Both screens are bright and sharp. While the ThinkPad 360C and 360P have the same 8.3-by-11.75-inch footprint, the ThinkPad 360P is slightly thicker and heavier.

Both units offer the built-in TrackPoint II pointing stick and can accommodate two Type II or one Type III PCMCIA device. Unfortunately, the unhinged PCMCIA port cover must be pried off with a screwdriver and is easily misplaced.

Both units scored well within their processor group on most benchmark tests. The ThinkPad 360P came with a 360MB hard disk, while the ThinkPad 360C came with a 170MB disk; this accounts for the distinct spread in their scores on our DOS disk tests. The ThinkPad 360P had the best DOS disk score among SX/33-based machines; the ThinkPad 360C fell into the bottom half. Both units posted below-average Disk WinMark scores.

The units scored well on our DOS video test, but fell to the bottom half of the pack on the Graphics WinMark test. Both systems finished with similar below-average Winstone scores. Battery life was admirable, at 5 hours 39 minutes for the ThinkPad 360C and 4 hours 45 minutes for the ThinkPad 360P.

Both systems offer enough features to make them worthy of serious consideration. IBM offers a 1-year warranty with an on-site service charge of \$40 for one year.—Robert S. Anthony



► FACT FILE

IBM ThinkPad 360C

List price (tested configuration): \$4,339 **Configuration:** Intel 486SX/33, 8MB RAM, IBM 170MB IDE hard disk with 32K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, IBM PC DOS 6.3, Microsoft Windows 3.1, integrated TrackPoint II pointing device **Options:** ThinkPad Dock I, \$899, Mobile communications module, \$1,999

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

IBM ThinkPad 360P

List price (tested configuration): \$4,239 **Configuration:** Intel 486SX/33, 8MB RAM, IBM 327MB ST-506 hard disk with 32K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, DOS 6.21, Microsoft Windows 3.1, integrated TrackPoint II pointing device. **Options:** ThinkPad Dock I, \$899, Mobile communications module, \$1,999.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

IBM Personal Computer Co., Route 100, Somers, NY 10589; 800-772-2227, fax, 800-426-4329, 539 on reader service card

IBM Personal Computer Co.



EDITORS' CHOICE

IBM ThinkPad 755C

IBM's ThinkPad line has a well deserved reputation for ruggedness, design, and performance—for a price. Among full-featured notebooks, the \$7,389 DX4/75-powered ThinkPad 755C stands alone.

The now-familiar 10.4-inch active-matrix color screen, TrackPoint II pointing stick, and flip-up keyboard have all been retained from the 486SL/33-powered ThinkPad 750C. New features for

the 6.4-pound unit (7.4 pounds, travel weight) include microphone and external-speaker jacks in addition to the standard I/O, video, and docking station ports.

The ThinkPad 755C performed very well on our DOS-based benchmark tests, posting the top score in this roundup on the DOS disk tests and the second-highest score on the DOS video tests. The unit also earned strong scores on the processor and DOSmark tests. Its Graphics WinMark and Disk WinMark scores fell near the middle of the pack, however; and while the ThinkPad 755C's Winstone score was strong for the entire group, it was sixth among the seven DX4/75 machines we tested.

Battery life on our ZDigit test was excellent for the nickel hydride-powered unit; lasting 5 hours 9 minutes, the ThinkPad 755C just edged out the Gateway ColorBook for top honors in its processor class. In fact, it bested most other systems, many of which are powered by slower, less power-hungry processors. ThinkPads retain their status as road-ready powerhouses for those who can afford them.—RSA



► FACT FILE

IBM ThinkPad 755C

List price (tested configuration): \$7,389 **Configuration:** Intel DX4/75, 8MB RAM, IBM 540MB IDE hard drive with 32K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated TrackPoint II pointing device, IBM PC DOS 6.3, Microsoft Windows 3.1 **Options:** ThinkPad Dock I, \$899, Mobile communications module, \$1,999

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	EXCELLENT
Road warrior	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

IBM Personal Computer Co., Route 100, Somers, NY 10589, 800-772-2227, fax, 800-426-4329

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■ IBM ThinkPad Dock I

If you agree that image is everything, the IBM ThinkPad Dock I may be the docking station for you. Its design integrates multimedia better than any docking station we've seen.

The unit works with the IBM ThinkPad 750 and 360 series, including the ThinkPad 755C, reviewed here. Inside is one 16-bit slot and one drive bay, and on the back are parallel, serial, VGA, PS/2 mouse, PS/2 keyboard, floppy disk drive, and SCSI ports. Since the notebook has sound on board, there are in and out jacks for the included speakers and a head-phone jack as well.

Unlike any other docking station, the ThinkPad Dock I comes with a handle to carry both it and the notebook. It also support simultaneous external display: The external video mode will handle resolutions of up to 1,024-by-768, while the LCD display goes as high as 640-by-480.

On the downside, the IBM ThinkPad Dock I has an annoying fan that runs as long as the notebook is connected, even when the power is shut off. And making a clean connection can be difficult, even though you slide the notebook in to seat it and secure it with a latch.—CB

► **ThinkPad Dock I.** List price: \$899. Options: CD-ROM drive, \$599; keyboard, \$155; 15-inch VGA monitor, \$675; PCMCIA port replicator, \$299; basic port replicator, \$109. IBM Personal Computer Co., Route 100, Box 100, Somers, NY 10589, 800-772-2227. Circle 539 on reader service card

Intelligent Notebook Systems Inc.

- **Intelligent Executive EchoBook DX4-75**
- **Intelligent Professional EchoBook DX2-50**
- **Intelligent Value EchoBook DX-33**

With its EchoBook series, Intelligent Notebook Systems tries to cover a wide range of uses by providing a group of notebooks that vary in processing power and screen technology. The three units reviewed here are the high-end \$5,345 active-matrix color Intelligent Executive EchoBook DX4-75, the \$3,145 dual-scan passive-matrix color Intelligent Professional EchoBook DX2-50, and the \$2,345 monochrome Intelligent Value EchoBook DX-33. The screens of the two color EchoBooks offer rich color and sharp images, but the monochrome screen of the Intelligent DX-33 looks streaky in Windows.

Each of the three EchoBooks features a pushed-back keyboard and a comfortable and easy-to-use trackball embedded in the wrist-rest area. While the EchoBooks offer audio features, such as jacks for external microphones and audio input and output, the built-in microphone in each provides disappointing results.

The Intelligent DX4-75 was a strong performer on most of our benchmark tests, while the Intelligent DX2-50 and DX-33 were average performers in their respective processor groups. On our Winstone tests, the Intelligent DX4-75 finished near the top of the pack, while the other EchoBooks posted average scores. The Intelligent DX4-75 managed strong DOS disk and Disk WinMark scores, while the other two units yielded average scores. All of the EchoBooks posted average processor scores within their test groups. The Intelligent DX-33 beat out its cousins on our DOS video tests, and all of the EchoBooks fared well on our Graphics WinMark tests.

The Intelligent DX-33 provided just over 3 hours of battery life, but the Intelligent DX2-50 and Intelligent DX4-75 provided just 2 hours 36 minutes and 1 hour 49 minutes, respectively. Each system uses nickel hydride cells and has extensive

power-management capabilities.

Intelligent Notebook Systems' range of alternatives ensures a notebook for every use.—RSA



► FACT FILE

Intelligent Executive EchoBook DX4-75

List price (tested configuration): \$5,345. **Configuration:** Intel 486DX4/75, 20MB RAM, Toshiba 524MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 14,400-bps fax

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Desktop replacement	GOOD
Road warrior	POOR

Intelligent Professional EchoBook DX2-50

List price (tested configuration): \$3,145. **Configuration:** Intel 486DX2/50, 8MB RAM, Toshiba 340MB IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps fax

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

Intelligent Value EchoBook DX-33

List price (tested configuration): \$2,345. **Configuration:** Intel 486DX/33, 8MB RAM, Toshiba 210MB IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.0, Microsoft Windows 3.1. **Options:** Docking station, \$295; port replicator, \$150; battery, \$95; SCSI-2 CD-ROM interface module, \$195.

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

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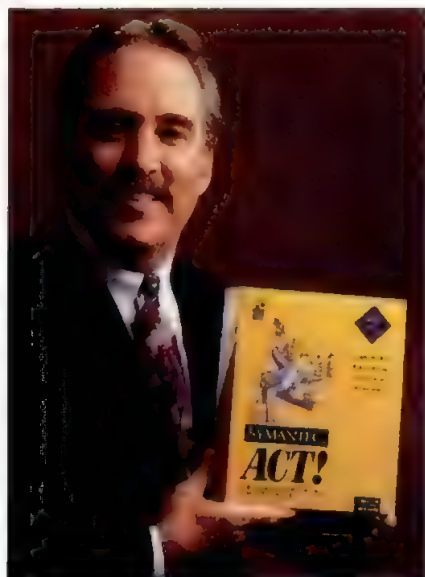
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CIRCLE 344 ON READER SERVICE CARD

Panasonic Personal Computer Co.

● Panasonic CF-V21P

The \$4,999 Panasonic CF-V21P is a high-end notebook with a unique feature: the ability to remove the floppy disk drive and replace it with another device, such as a mini-CD-ROM drive. Unfortunately, few titles are available on this format; and at 8.2 pounds, the system is heavy.

The unit has a 10.4-inch active-matrix color screen that can be removed and flipped or upgraded to a pen screen or a dual-scan color or passive monochrome screen. Its hard disk, like the floppy disk drive, is removable. You can trade the latter for either the \$499 3.5-inch 180MB mini-CD-ROM unit, which is mainly used to distribute corporate data, another battery pack, or a TV tuner module.

For expansion, the CF-V21P has a Type III PCMCIA slot and an expansion bus port that links to the optional docking station or port replicator. The hard disk is upgradable to 450MB, RAM to 20MB, and the CPU to a DX4/75.

Disk performance was below average under both Windows and DOS, but the system's DOS video and Graphics WinMark

scores were solid. DOSmark, Winstone and processor scores were below average for its CPU class. Its nickel hydride battery lasted 2 hours 32 minutes on our battery tests; users who need longevity should take advantage of the extra battery pack.

This unit offers a lot of flexibility for upgrading (or downgrading) to suit most user needs, but lags in performance.—AY

Sharp Electronics Corp.

● Sharp PC-8150T

● Sharp PC-8650T

Twinhead Corp.

● Twinhead Slimnote 486E 4DX2/66T

After a short hiatus, Sharp Electronics Corp. is returning to the notebook business with two DX/33-based machines, the \$3,423 Sharp PC-8150T and the \$3,723 Sharp PC-8650T. Twinhead Corp. also offers the same notebook under its own name, the \$4,827 Twinhead Slimnote 486E 4DX2/66T. Twinhead outfits the system very differently, however, starting with the implementation of the DX2/66 chip.

Each of the Sharp machines comes with an external add-on trackball that attaches to the front of the unit. The Twinhead Slimnote offers an internal trackball in the upper-right-hand corner, with two buttons on the side. Both approaches work well, though the Sharp units' trackballs are larger and thus slightly easier to use. The Twinhead Slimnote's travel weight is 8 pounds 8 ounces; the Sharp units each hit the road at under 8 pounds.

The Twinhead Slimnote offers a 9.3-inch NEC-made active-matrix screen that is almost an inch bigger than the Sharp PC-8650T's 8.5-inch proprietary active-matrix screen. Each is more than adequate for Windows applications, though we prefer the Sharp PC-8650T's smaller, clearer screen and its sharper colors. The Sharp PC-8150T's 9.5-inch dual-scan color screen simply doesn't compare with the screens of the other two units.

On our benchmark tests, the Twinhead Slimnote was a consistent performer, landing in the top 20 on all of our tests and garnering a first-place score on our DOS-based video tests. The unit placed third on our processor tests and fifth on our Graphics WinMark tests, and



► FACT FILE

Sharp PC-8150T

List price (tested configuration): \$3,423 Configuration: Intel 486DX/33 SL, 8MB RAM, Toshiba 213MB IDE hard disk, 1.44MB floppy disk drive,

14,400 bps fax modem, snap-on trackball, DOS 6.0, Microsoft Windows 3.1 Options: 4MB RAM, \$299, nickel hydride battery, \$175; port replicator, \$149; keyboard/mouse adapter, \$25

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **POOR**

Sharp PC-8650T

List price (tested configuration): \$3,723 Configuration: Intel 486DX/33 SL, 8MB RAM, Toshiba 213MB IDE

hard disk, 1.44MB floppy disk drive, 14,400-bps fax modem, snap-on trackball, DOS 6.0, Microsoft Windows 3.1 Options: 4MB RAM, \$299, nickel hydride battery, \$175; port replicator, \$149; keyboard/mouse adapter, \$25

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

Road warrior **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair service **AVERAGE**

Technical support **BELOW AVERAGE**

Sharp Electronics Corp., Sharp Plaza, Box F1, Mahwah, NJ 07430-2135; 800-237-4277; fax-back, 201-529-9113. 481 on reader service card



► FACT FILE

Panasonic CF-V21P

List price (tested configuration): \$4,999 Configuration: Intel 486DX2/50, 8MB RAM, Seagate 210MB ST-506 hard disk with 64K cache, 1.44MB floppy disk drive, 3.5-inch CD-ROM drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1 Options: 4MB RAM card, \$399, CD-ROM drive, \$499

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

Panasonic Personal Computer Co., Two Panasonic Way, Secaucus, NJ 07094, 800-742-8086, 201-271-3182, fax, 201-392-6618

540 on reader service card

it posted a sixth-place DOSmark score and an eleventh-place Winstone score.

The Sharp PC-8150T and Sharp PC-8650T ranked consistently in the lower half of the units here—the low point being their decidedly unimpressive scores on our DOS-based video tests (55th and 67th, respectively). These showings compare with the Twinhead Slimnote's first-place DOS video score. This radical polarity was mostly due to the units' different processors, but the Twinhead Slimnote's ISA/VL-Bus architecture didn't hurt. (The Sharp notebooks each use ISA-bus architecture.) In general, however, the Sharp units performed rea-

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► FACT FILE

Twinhead Slimnote 486E 4DX2/66T

List price (tested configuration): \$4,827 **Configuration:** Intel 486DX2/66, 8MB RAM, Toshiba 340MB IDE hard disk with 256K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS 6.2, Microsoft Windows 3.1. **Options:** 4MB RAM, \$219; 16MB RAM, \$1,199; battery, \$125; AC adapter, \$85; automobile adapter, \$65; I/O slice, \$129.

Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035, 800-995-8946, 408-945-0808; fax, 408-945-1080.

482 on reader service card

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Desktop replacement	GOOD
Road warrior	FAIR

sonably well within their chip group; the Sharp PC-8650T scored mostly average marks, while the Sharp PC-8150T's scores hovered just below the average mark.

While these three machines currently comprise the two companies' entire notebook offerings, Twinhead also has a line of subnotebooks, and Sharp will have announced new notebooks by the time you read this.—*Mary E. Behr*

Texas Instruments Inc.

• TI TravelMate 4000E WinDX2/50 DSC

• TI TravelMate 4000E WinDX2/50 Monochrome

The \$3,299 TI TravelMate 4000E WinDX2/50 dual-scan passive-matrix color system and its \$2,899 monochrome sibling are just two examples of a large line of Texas Instruments' TravelMate 4000E systems that begins with a 486SX/25 monochrome unit and runs up to a DX4/75 active-matrix color system.

The simple case design has few frills and one flaw: the lack of PCMCIA support (a rarity today). An expansion slot in the rear



■ THV-0002 Docking Station

Twinhead Corp.'s \$519 THV-0002 Docking Station is a two-part affair: The base unit holds the notebook in a carrier that slides back and connects with the I/O module. But the notebook doesn't lock onto the unit.

The I/O module comes with one parallel and two serial ports, as well as a VGA, a PS/2 mouse, and a PS/2 keyboard port; there is also a dedicated modem and a phone jack that connects to the notebook's internal modem. The I/O module can accept a 2.5-inch hard disk and a 10BaseT network adapter. There is room in the base unit for two front-accessible drives—a 3.5- and a 5.25-inch—and three 16-bit slots. The docking station uses the notebook's IDE controller, so you can use it for the 2.5-inch drive in the I/O module or for a drive in the base unit. But you can't use it for both.

The docking station can trickle-charge the notebook when docked, but in order to quick-charge, you must connect the AC adapter. You should be able to use the external VGA, though we had problems trying to get the external VGA display to be recognized. We also had problems attaching an external keyboard.—*CB*

► **THV-0002 Docking Station.** **List price:** \$519. **Options:** 10baseT network adapter, \$89; 4MB RAM module, \$219; 16MB RAM module, \$1,199; battery, \$119. Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; 800-995-8946, 408-945-0808; fax, 408-945-1080.

Circle 550 on reader service card

of the machine accommodates an optional docking station (see accompanying review). The color unit's dual-scan display is easy on the eyes and is well worth the extra \$400; the active-matrix color version of the TI TravelMate 4000E WinDX2/50 costs \$4,607 with a similar configuration.

On our benchmark tests the systems proved to be average performers overall. On our DOS-based tests, the monochrome unit posted the best processor score among DX2/50-based machines



► FACT FILE

TI TravelMate 4000E WinDX2/50 DSC

List price (tested configuration): \$3,299. **Configuration:** Intel 486DX2/50, 8MB RAM, Seagate 210MB IDE hard disk with 8K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, DOS 6.2, Microsoft Windows 3.1, snap-on trackball. **Options:** 4MB RAM upgrade, \$279; TravelMate Desktop Intelligent Docking System, \$899; internal battery pack, \$89.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR

TI TravelMate 4000E WinDX2/50 Monochrome

List price (tested configuration): \$2,899. **Configuration:** Intel 486DX2/50, 8MB RAM, Seagate 210MB IDE hard disk with 8K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, DOS 6.2, Microsoft Windows 3.1, snap-on trackball. **Options:** 4MB RAM upgrade, \$279; TravelMate Desktop Intelligent Docking System, \$899; internal battery pack, \$89.

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	POOR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

482 on reader service card



■ TI Intelligent Docking System

Texas Instruments' \$899 TI TravelMate Desktop Intelligent Docking System works only with the TI TravelMate 4000 and 4000E notebook series and is the only motorized docking station we reviewed; just place the notebook in the slot, press a button, and it's accepted VCR-style.

The TravelMate Docking System comes with four drive bays and can easily handle a CD-ROM drive. The unit also has a floppy controller and a SCSI-II controller. The unit even accepts PCMCIA cards—it comes with two Type III slots. (The notebook lacks PCMCIA slots.) It can also be operated vertically. A lock secures the notebook and its integrated display shelf (to hold a VGA monitor) can be removed to use the LCD as the primary display.

The unit has all the ports you'll need: high-speed parallel, two serial, VGA, PS/2 mouse, AT keyboard, RJ-11 (which connects to the notebook's internal modem), and a game port. While it doesn't have a network card or audio jacks, it has six 16-bit slots. TI recently shipped a new CD-ROM-equipped, battery-powerable docking station for its TI TravelMate 4000M notebook series; that docking station also costs \$899.—CB

► **Texas Instruments TravelMate Desktop Intelligent Docking System.** List price: \$899. Texas Instruments Inc., PO Box 149149 MS 2240, Austin, TX 78714-9149; 800-848-3927, 512-794-5970; fax, 512-250-7329.

Circle 546 on reader service card

with the dual-scan model finishing a close second. This score boosted the units' DOSmark scores above the average despite the systems' poor showings on our DOS disk and DOS video tests.

The 210MB Seagate hard disk raised the units' Disk WinMark and Winstone scores. Both systems are equipped with Cirrus Logic video chip sets and turned in below-average scores on our Graphics WinMark test. Battery life ranged from fair to good: The monochrome unit lasted for just under two hours, while the color notebook lasted a respectable 3 hours 15 minutes.

Texas Instruments offers a toll-free technical-support line that operates from 7 A.M. to 7 P.M. central time, and the TI TravelMate 4000E line comes with a one-year parts-and-labor warranty and one year of on-site service for \$129.

The TI TravelMate 4000E line is a strong group of notebooks worthy of the Texas Instruments label. Nor is it the only such series: The TI TravelMate 4000M line (one example of which is reviewed below) also comprises well-designed, solid performers.—WPF

Texas Instruments Inc.

EDITORS' CHOICE TI TravelMate 4000M

Although its \$3,799 price may seem steep, the 25-MHz TI TravelMate 4000M garnered top scores in its processor category on most of our benchmark tests and has an active-matrix color display. TI continues its tradition of notebook excellence with this TravelMate.

Compared with the TI TravelMate 4000E series reviewed here, the TI TravelMate 4000M series is sleeker and more aesthetically pleasing; it also adds a built-in pointing device. Called The Point, this mouse substitute is comfortable and easy to use. In addition, the system includes a Type III PCMCIA slot, a MIDI port, and a SCSI-2 connector that allows you to daisy-chain up to seven SCSI devices or connect to an optional CD-ROM docking station. There are a few shortcomings, including an 8.5-inch display that is smaller than the competition.

The TI TravelMate 4000M's performance on our benchmark tests eclipsed the majority of other 25-MHz systems



► FACT FILE

TI TravelMate 4000M

List price (tested configuration): \$3,799 Configuration: Intel 486SX/25, 8MB RAM, Seagate 210MB IDE hard disk with 8K cache, 1 44MB floppy disk drive, 14,400 bps fax modem, integrated pointing device, DOS 6.2, Microsoft Windows for Workgroups 3.11. Options: 4MB RAM upgrade, \$279; CD-ROM docking station, \$899.

Texas Instruments Inc.
P.O. Box 149149 MS
2240, Austin, TX 78714-9149; 800-848-3927,
512-794-5970, fax, 512-250-7329
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SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

Road warrior **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **ABOVE AVERAGE**

Technical support **ABOVE AVERAGE**

with few exceptions. The unit's 210MB Seagate hard disk and Cirrus Logic 6440/Vision video chip set helped it to post top scores on the Disk WinMark, Graphics WinMark, Winstone, processor, and DOS-based video tests. The DOSmark score was also the best of the group. The only low point for the system was its average performance on the DOS-based disk tests.

The TI TravelMate 4000M is a winner with few shortcomings. A 75-MHz version promises even greater performance.—WPF

Toshiba America Information Systems

● Toshiba Satellite T1910

Toshiba America Information Systems' Satellite line is aimed at budget-minded users who want the power of a 486. The SX/33-based Toshiba Satellite T1910 is priced and configured to be the entry point of this entry-level line of machines; those seeking more options and features should look to the Toshiba T4600, T4700,

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Dual scan color: 3.0 - 7.0 hrs
Active matrix color: 3.5 - 7.0 hrs
Dual scan color pen: 3.3 - 7.0 hrs
(Depends on usage/configuration)

PCMCIA Support: 2 Type I, 2 Type II
or 1 Type III

Hard Disk: 170, 340 MB

Weight: Mono: 5.6 lbs
Dual scan color: 6.2 lbs
TFT color: 6.1 lbs / Pen: 6.8 lbs

Warranty: 1-Year International**

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► FACT FILE

Toshiba Satellite T1910

List price (tested configuration): \$1,900 (estimated)

Configuration: Intel 486SX/33, 8MB RAM, Toshiba 130MB IDE hard disk with 8K cache, 1 44MB floppy disk drive, 14,400-bps fax modem, integrated trackball, DOS

6.2, Microsoft Windows

Options: 4MB memory card, \$399, 8MB memory card, \$679; 16MB memory card, \$2,549; battery pack, \$139; battery-pack recharger with AC adapter, \$175

Toshiba America Information Systems
9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-583-3800.
469 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR
Road warrior	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	Average
Repair service	AVERAGE
Technical support	AVERAGE

and T4800 notebooks.

Toshiba Satellites are the notebooks you'll find on sale at your local mass-merchandise discounter. The tested unit, with a monochrome screen and a 130MB hard disk, should have a street price of less than \$2,000—complete with a "productivity bundle," which includes Lotus Organizer and ClarisWorks for Windows.

This unit, with a travel weight of 7.5 pounds, provides an impressive combination of low-power components and power management, which helped it achieve excellent battery life on our tests (5 hours 20 minutes). The system comes with a nickel hydride battery.

Other strong points include a full-function, adjustable tilt keyboard with generous key spacing and the familiar feel of a desktop keyboard. The snap-on trackball mounts easily and is nicely sized. There is also a PS/2 mouse port.

Performance was generally in line with the system's SX/33 CPU. A main shortcoming was the monochrome screen,

which has generous size but a dull display with no brightness control.—*Steve Potter*

Toshiba America Information Systems

• Toshiba T4700CS

With the Toshiba T4700CS, Toshiba ably combines the power of a multimedia desktop PC with the portability of a notebook. Reasonably priced, the Toshiba T4700CS is a good all-around notebook for general use.

Aimed squarely at traveling salespeople and other road warriors who need to make sophisticated presentations, the \$3,918 Toshiba T4700CS—with a 213MB hard disk and dual-scan color display—offers a host of attractive features but ultimately falls short of being a full-fledged multimedia portable.

Despite its much-heralded Western Digital RocketCHIP local-bus video controller, the system delivered video performance that was below average for machines in its CPU category. Its dual-scan



► FACT FILE

Toshiba T4700CS

List price (tested configuration): \$3,918. **Config-**

uration: Intel 486DX2/50, 8MB RAM, Toshiba 213MB IDE hard disk with 8K cache, 1 44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, integrated trackball,

DOS 6.2, Microsoft Windows for Workgroups 3.11 **Options:** 4MB RAM card, \$399; 8MB RAM card, \$679; 16MB RAM card, \$2,549, 14,400-bps fax modem, \$329

Toshiba America Information Systems; 9740 Irvine Blvd., Irvine CA 92718; 800-334-3445, 714-583-3000; fax, 714-583-3800.

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SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
Road warrior	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE



■ Toshiba Desk Station IV

The \$649 Toshiba Desk Station IV is a functional docking station for Toshiba's 2200, 3300, and 4400-4800 notebook series. (The Toshiba T3400 Portege has a port replicator of its own.)

The notebook slides on and is snapped in place by two spring-mounted clasps, which can make it difficult to determine if you have a good connection. You can use the notebook's LCD as the primary display, or you can slip a display stand on the docking station to hold a VGA monitor. Simultaneous display is available.

All the ports are on the back; a lock is on the right side of the case. The station has parallel, serial, VGA, PS/2 mouse, and PS/2 keyboard ports and a floppy disk port. There's also a single 5.25-inch drive bay and two 16-bit slots. Since the power switch is on the notebook, Toshiba's convenient suspend and resume features remain enabled.

While this docking station is a bit long in the tooth, Toshiba has been spearheading the Plug and Play initiative with Microsoft to make hot docking and graceful undocking a reality. The fruits of those efforts are expected after Microsoft's Chicago ships.—*CB*

► **Toshiba Desk Station IV.** List price: \$649. Options: None as of press time. Toshiba America Information Systems, 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-583-3800.

Circle 469 on reader service card

color display provides rich colors but lacks the wide-angle view of an active-matrix screen required for medium-to-large presentations. If delivering road-show presentations is critical, you may want to spend the extra \$1,600 for a Toshiba T4700CT, which has an active-matrix color display.

Intel's 3.3-volt DX2/50 processor gives good performance, and the nickel hydride battery pack—combined with effective energy management techniques—provides a lengthy 4 hours 32 minutes of running time.

The keyboard is top-notch for a notebook, while the BallPoint mouse snaps conveniently onto the right side of the machine and provides good cursor control. The in-office flexibility offered by the Toshiba Desk Station IV docking station (see accompanying review) is enhanced by the chassis's two PCMCIA expansion slots, serial and parallel ports, and ports for a color monitor, PS/2 keyboard, and mouse.—SP



► FACT FILE

Toshiba T4800CT

List price (tested configuration): \$6,868 **Configuration:** Intel 486DX4/75, 8MB RAM, Toshiba 524MB IDE hard disk with 16K cache, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, snap-on trackball, DOS 6.2, Microsoft Windows 3.11. **Options:** 4MB RAM card, \$399; 8MB RAM card, \$679; 16MB RAM card, \$2,549.

14,400-bps fax modem, \$329, nickel hydride battery pack, \$139

Toshiba America Information Systems, 9740 Irvine Blvd., Irvine CA 92718; 800-334-3445, 714-583-3000; fax, 714-583-3800.

469 on reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	EXCELLENT
Road warrior	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Toshiba America Information Systems

• Toshiba T4800CT

Yes, it's expensive at \$6,868, but the Toshiba T4800CT is a well-rounded DX4/75-based notebook that offers formidable performance under Windows and useful multimedia and connectivity features. At 8.5 pounds, however, this notebook is quite heavy.

The unit's 9.5-inch active-matrix screen offers bright, clear images, while its keyboard reflects some of Toshiba's core competence. The sculpted, clip-on trackball is easy to use, but the lack of an integrated pointing device is a definite shortcoming.

The unit gains points for its nice design touches, which include a slide-away door over the trackball connector port, a convenient memory-card port, and a proprietary, oversized PCMCIA port that lets you connect a phone plug directly into the side of a thick card. The unit offers jacks for an external microphone and an external speaker, and there's a tiny microphone built into the bottom of the screen that is surprisingly good at recording short voice messages.

The unit fared well on most of our benchmark tests, but its scores on the two disk tests varied widely. The unit was second only to the DX4/100-based Ambra N100T on our Disk WinMark tests (possibly the result of its use of Microsoft Windows for Workgroups) but finished dead last among the DX4/75 systems on our DOS disk tests.

The Toshiba T4800CT had the top processor score among the DX4/75-based machines in this roundup, as well as strong Winstone and Graphics WinMark scores. Battery life was strong at 4 hours 32 minutes.—RSA

WinBook Computer Corp.

EDITORS' CHOICE

WinBook XP DX2/50 4/260 Monochrome

With plenty of processing power, enough battery life to handle a trans-continental flight easily, and a \$2,098 price tag, the WinBook XP 486DX2/50-based monochrome unit is a value winner.

The WinBook XP DX2/50 4/260 Monochrome borrows the best features from the



► FACT FILE

WinBook XP DX2/50 4/260 Monochrome

List price (tested configuration): \$2,098 **Configuration:** Intel 486DX2/50, 8MB RAM, Toshiba 260MB IDE hard drive with 16K cache, 1.44MB floppy disk drive, 14,400-bps fax modem, integrated pointing device, DOS 6.2, Microsoft Windows 3.1 **Options:** 16MB RAM upgrade, \$799, docking station, \$599

WinBook Computer Corp., 1160 Steelwood Rd., Columbus OH, 43212-1356; 800-468-2162, 614-481-7460; fax, 800-448-0308.

470 on reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD
Road warrior	GOOD

systems of an unlikely pair: IBM and Apple. This system has an admirable travel weight of 6.5 pounds. Like Apple PowerBooks, the WinBook provides an ample wrist-rest area. Like IBM ThinkPads, the WinBook XP has a pointing stick between the "G" and "H" keys and uses a similar Lexmark keyboard. Unlike any other system, the WinBook offers you a choice between the pointing stick and a large trackball; or for just \$29.95 you can buy both. Another nice touch is the system's LCD status screen that, among other things, lets you know how much battery time is left.

The WinBook XP, which came with a 260MB hard disk, scored in the middle of the review group on our Winstone, DOS disk, Disk WinMark, and DOS video tests. The unit fared better on the Graphics WinMark test and posted above-average DOSmark and processor scores. The obvious highlight of the WinBook XP was its phenomenal time on our battery rundown test. Lasting 9 hours 27 minutes, its nickel hydride battery pack provided more than double the battery life of most machines in this lineup. Clearly, the lower power demands of the passive-matrix monochrome screen prolonged battery life. The screen is upgrad-

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CIRCLE 020 ON READER SERVICE CARD

able, and newer WinBook XP models offer active and dual-scan screens. WinBook CPU options go as high as a DX4/75.—RSA

Zenith Data Systems

• ZDS Z-Lite 425L

The Z-Lite 425L from Zenith Data Systems has three things going for it: a great price for a fully equipped subnotebook (\$1,799), a good battery life (just over four hours), and a light weight (6 pounds 6 ounces travel weight). Its downfall is its trailing-edge performance.

The ZDS Z-Lite 425L has a 486SX/25 SL processor, two PCMCIA Type II slots, and an external floppy disk drive. An easy-to-use trackball is included that snaps onto the front edge of the notebook. Memory is user-upgradable to 20MB, and you can opt for a 170MB hard disk. Currently, ZDS offers only monochrome models, but screen quality is good and pictures are sharp. ZDS offers more full-featured notebooks through its Z-Star and Z-Noteflex lines.



▶ FACT FILE

ZDS Z-Lite 425L

List price (tested configuration): \$1,799 **Config-**

uration: Intel 486SX/25 SL, 8MB RAM, Seagate

172MB IDE hard disk,

1 44MB floppy disk

drive, 14,400-/9,600-bps

PCMCIA data/fax

modem, clip-on track-

ball, DOS 6.0, Microsoft

Windows 3.1 **Options:**

4MB RAM upgrade, \$99,

nickel hydride battery,

\$159, AC adapter, \$109

Zenith Data Systems,

2150 E. Lake Cook Rd.,

Buffalo Grove, IL 60089;

800-227-3360; fax, 708-

808-4883.

493 on reader service card

SUITABILITY TO TASK

DOS applications FAIR

Windows applications POOR

Desktop replacement FAIR

Road warrior FAIR

VENDOR SERVICE & RELIABILITY

Reliability BELOW AVERAGE

Repair service BELOW AVERAGE

Technical support BELOW AVERAGE

Performance is the ZDS Z-Lite's trouble spot, with the system reaching to make the average on all our benchmark tests. Aside from the terrific nickel hydride battery life of 4 hours 8 minutes, performance results were average to below average within its processor group. Its disk score under Windows was low, but showed some improvement under DOS. Video performance was the opposite: the unit's

Graphics WinMark score was average within its processor group, but its DOS video score was below average. The ZDS Z-Lite's DOSmark and processor scores were average within its CPU class, but Winstone numbers were below average.

This subnotebook comes at a bargain price, and users will no doubt appreciate its light weight; but you must take into account its lackluster performance.—AY□

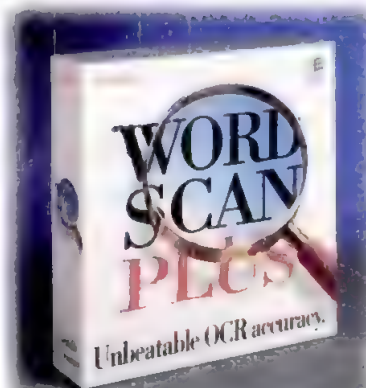
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PC MAGAZINE'S MOBILE COMPUTING GUIDE

On the Road

BEFORE YOU GO OUT ON THE ROAD, be sure you have the information and accessories you need to log in from hotel rooms or remote offices in the U.S. or abroad. *PC Magazine* has compiled a guide that includes the most important information you'll need while traveling:

- A road warrior's list of travel accessories, in case you have trouble deciding what to take and what to leave at home.
- Phone numbers and transmission

parameters of the major on-line services.

- Setup strings for popular portable modems and the technical-service phone numbers for the major modem makers.
- Electrical voltages and plug types used at major international destinations.
- A troubleshooting guide for when things don't work as smoothly as you expect.

We also recommend that you do the following: Write down the

phone numbers and parameters of your company's remote network gateway and remote electronic mail service, as well as the technical-support numbers for your portable PC and modem (if it's not one of the major ones we've listed). Before you travel, tape a business card to your computer, transformer, external modem, and floppy disk drive. That way, if in your mad dash to the airport you leave part of your PC in the hotel, you're more likely to get it back.

—Bill Howard

FEATURES PLUS

Download the contents of this section from ZiffNet's Editorial Forum. GO ZNT EDITOR and search on PORTABLE.

The Essential Traveler's Kit

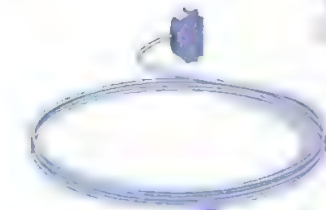
Before you leave, make sure you have all you'll need to make mobile computing as painless as possible. Augment this checklist with items suited to

the way you work. You might, for example, want to add a list of dial-in modem numbers for your office, with transmission specifications included.

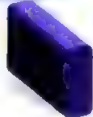
Toolkit with flashlight, pocket knife, screwdriver (with a spade on one end, a Phillips head on the other), and needle-nose pliers



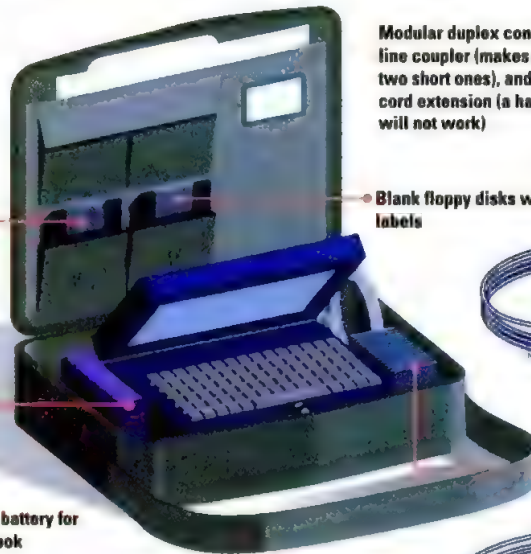
- Bootable floppy disk with backup AUTOEXEC.BAT, CONFIG.SYS, and WIN.INI files, as well as printer drivers for generic, HP LaserJet II and III, Epson, and PostScript printers



Transformer or extra battery and serial cable for external modem



- Spare battery for notebook



- Modular duplex connector (Y connector), in-line coupler (makes one long cable out of two short ones), and RJ-11 phone-cord extension (a handset cord will not work)



- Blank floppy disks with labels



- 3-prong-to-2-prong adapter and extension cord

- Transformer and power cord



- Velcro cable ties

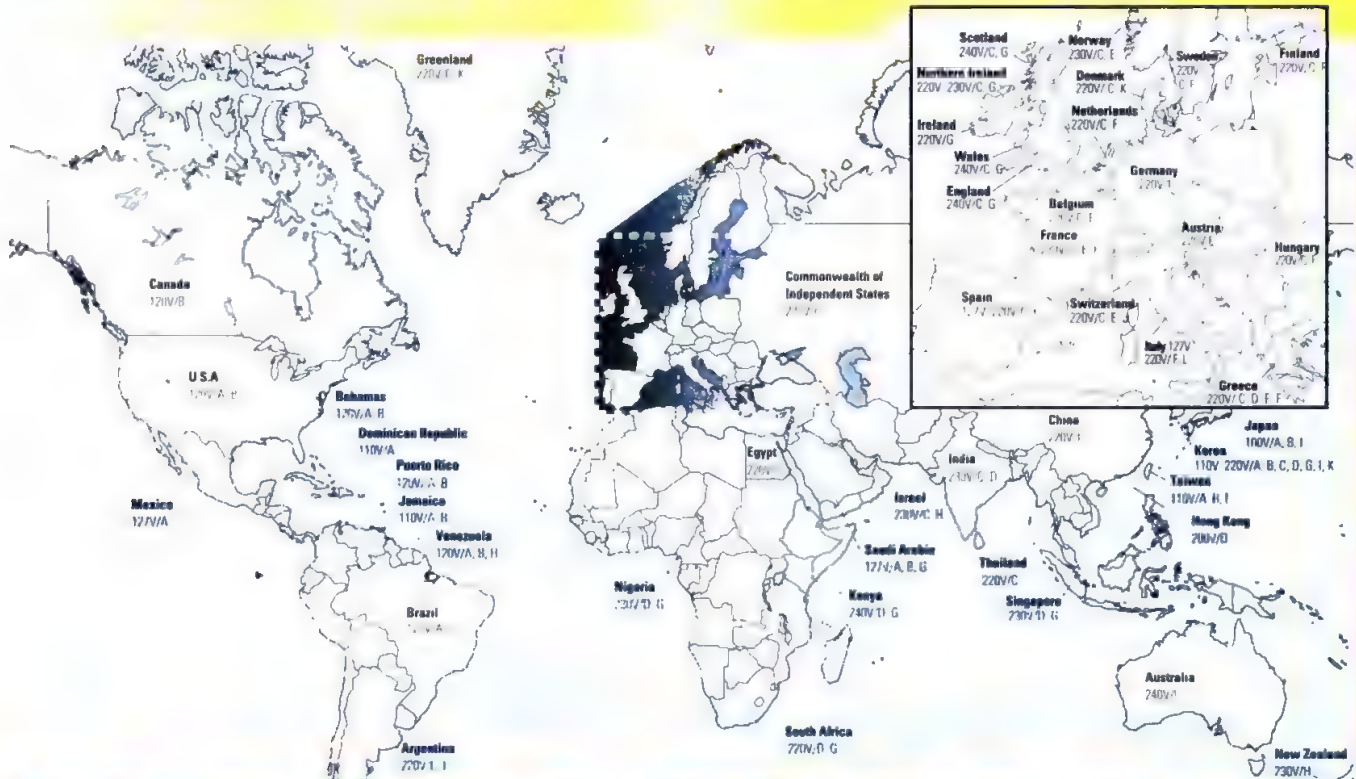


- Short printer cable

Support Information for the Top Notebook Vendors

If something goes wrong with your notebook, or if you're not sure about a certain feature, go to the source: the vendor who sold the system. After all, the vendor knows your notebook's capabilities about as well as anyone.

Company	Address	Customer information (telephone, fax)	Technical support (telephone, fax)	Technical support hours (eastern time)	Private BBS number	Automated telephone fax-back
Apple Computer Inc.	One Infinite Loop, Cupertino, CA 95014	800-778-2333	800-767-2775	9:00-9:00 M-F	None	800-776-2333
AST Research Inc.	16215 Alton Pkwy., Irvine, CA 92718	800-876-4278, 714-727-4141	800-876-4278, 714-727-4141	24 hours, 7 days	714-727-4723	800-926-1278
Compaq Computer Corp.	P.O. Box 692000, M120208, Houston, TX 77269-2000	800-345-1518, 713-378-8820; fax, 713-378-1442	800-652-6672, 713-378-8820; fax, 713-378-1447	24 hours, 7 days	713-378-1418	800-345-1518
Dell Computer Corp.	9505 Arboretum Blvd., Austin, TX 78759-7299	800-289-3355, 512-338-4400; fax, 800-727-8320	800-624-9896, 512-338-4400; fax, 800-727-8320	24 hours, 7 days	512-728-8528	800-950-1329
Gateway 2000 Inc.	610 Gateway Dr., North Sioux City, SD 57049-2000	800-846-2000, 605-232-2000; fax, 605-232-2023	800-846-2301	7:00 A.M.-1:00 A.M. M-F, 10:00-3:00 Sat.	605-232-2224	800-846-4526
Hyundai Electronics America	166 Bay Pointe Pkwy., San Jose, CA 95134	800-627-7978, 408-894-9710; fax, 408-894-9751	800-288-4986, 800-289-4986; fax, 800-964-4762	10:00-8:00 M-F	408-473-9899	800-724-4843
IBM Personal Computer Co.	Route 100, Somers, NY 10589	800-772-2227	800-772-2227	24 hours, 7 days	919-517-0001	800-426-4329
NEC Technologies Inc.	1414 Massachusetts Ave., Boxborough, MA 01719-2298	800-632-4636, 508-264-8000; fax, 508-264-8831	800-388-8888	8:30-8:00 M-F	508-635-4706	800-366-0476
Tandy Corp.	1800 One Tandy Center, Fort Worth, TX 76102	817-390-3011	817-390-3011	9:30-6:30 M-F, 9:30-1:00 Sat.	None	None
Toshiba America Information Systems Inc., Computer Systems Division	9740 Irvine Blvd., Irvine, CA 92718	800-334-3445	800-999-4273	10:00-8:00 M-F	714-837-4408	714-583-3800
Zenith Data Systems	2150 E. Lake Cook Rd., Buffalo Grove, IL 60089	800-227-3360, fax, 708-808-4883	800-227-3360, fax, 708-808-4883	8:00 A.M.-12:00 midnight, M-F	708-808-4942	None



On-Line Services

	America Online	AT&T Mail	CompuServe	MCI Mail	Prodigy
Connection Access					
300-2,400 bps	ADL software provides local numbers	800-624-5123	800-362-1295	800-456-6245*	Call 800-776-3449 for local numbers
9,600 bps	ADL software provides local numbers	Call 800-624-5672 to request access	800-847-5260	800-456-6245*	Call 800-776-3449 for local numbers
14,400 bps	N/A	Call 800-624-5672 to request access	N/A	N/A	N/A
Support					
Customer support number	800-827-6364	800-624-5672	800-638-9636	800-444-6245	800-776-3449
Hours (eastern time)	9 A.M.-2 A.M. M-Sat noon-9 P.M. Sun	24 hours, 7 days	9 A.M.-midnight M-F noon-8 P.M. Sat, Sun, and holidays	24 hours, 7 days	24 hours, 7 days
Performance					
Speed	1,200-9,600 bps	2,400-14,400 bps	300-9,600 bps	300-9,600 bps	1,200-9,600 bps
Data bits	8	8	7	8	Presel
Parity	None	None	Even	None	Presel
Stop bits	1	1	1	1	Presel
Flow control	Active (at 9,600 bps)	XON/XOFF	XON/XOFF	XON/XOFF	Presel
International Access					
Canada	N/A	Call customer support (800-624-5672) before you leave the U.S. for access numbers.	Call customer support (800-638-9636) before you leave the U.S. for access numbers.	1) Obtain an access number for Datapac (a Canadian packet-switching service) from MCI Mail before you leave the U.S. by typing "HELP PHONES" and a region such as "ONTARIO" 2) From Datapac, type " " (two periods) and press Enter 3) Type "13106" and press Enter 4) Type "MCI MAIL USA" and press Enter	N/A
Other countries	N/A	Call customer support (800-624-5672) before you leave the U.S. for access numbers.	In Austria, Germany, or Switzerland, call 49 2233 6091. In Japan, call 81-01 2000 9805. Call customer support (800-638-9636) before you leave the U.S. for other access numbers.	A) Get an MCI Mail Global Access number before you leave the U.S. by typing "HELP PHONES INTERNATIONAL" or B) Subscribe to the country's packet-switching service or C) Call one of MCI Mail's two toll access numbers: 703-414-0750 (Washington, D.C. area) or 415-543-6364 (San Francisco area)	N/A

N/A = Not applicable. The service does not have this feature. * In Puerto Rico or the U.S. Virgin Islands, call 800-456-6245.

Modem Commands

Tired of leafing through the manual to set up your modem on the road? We list some basic setup strings for popular modems, along with selected commands for the Hayes-compatible command set. We also include technical-support times and numbers—for those times when all else fails.

Company/Technical Support Info	Modem	Setup String
Hayes Microcomputer Products Inc. 404-441-1617, 8:00-5:30 M-F (eastern time)	Optima 144 • FAX144 (PCMCIA) Optima 24 • FAX96 (PCMCIA) Optima 144 • FAX144 Pocket Edition (external, four 1.5V batteries)	AT&F&N1201
Intel Corp. 800-458-6231, 8:00-5:00 M-F (Pacific time)	Intel Fax Modem 96/96 (PCMCIA) Intel Fax Modem 14.4/14.4 (PCMCIA)	Normal: AT&F MNPS: AT&F%C1 V42 bis: AT&F%N2
Megahertz 800-527-8677, 8:00-5:00 M-F (mountain time)	P296FMV (external, one 9V battery) XJ2144 (PCMCIA) CC4144 (PCMCIA)	Normal: AT&F&C1&D2&Q8&S1W2S95--N%CG&W8&K1 MNPS: AT&F&C1&D2&Q8&K3&S1&W--ENTER AT&F&N1201 V42 bis: AT&F&C1&D2&Q8&K3&S1W2S95-18&W
Microcom Inc. 617-551-1313, 8:00-7:00 M-F (eastern time)	TravelPort 14.4 (external, one 9V battery) and TravelPort Fast 28.8 (external, one 9V battery) pocket modems	Normal: AT&F%N0 MNPS: AT&F%N2%C1 V42 bis: AT&F%N2%C3
Motorola Inc. 800-451-2369, 7:30-7:00 M-F (central time)	Motorola Select 14.4 (PCMCIA) Motorola Select pocket modem (external, one 9V battery)	AT&F *
U.S. Robotics Inc. 708-982-5151, 8:00-6:00 M-F (central time)	WorldPort 14.4 (external, one 9V battery, or PCMCIA) WorldPort Dual Standard 14.4 (PCMCIA)**	Noncellular: AT&F&A3&B1&H1&R2K757-90 or AT&F1 * Cellular: AT&F3 *

Command

Note: AT—attention—begins every command line except A/ and ++.

Command	Description
ATA	Answer the phone
ATDT	Dial using tone dialing
ATDP	Dial using pulse dialing
ATDS=x	Dial phone number in memory position x
ATH	Hang up the phone
A/	Repeat last command (command does not begin with AT or end with <Enter>)
ATS0=x	Answer after x rings
ATS=a,b	Turn off auto-answer
ATX00	Force connection after modem answers (if number is manually dialed)
ATZ	Reset
ATMD	Shut speaker off (M1, speaker on unit); on-line; M2, speaker always on; M3, speaker on until on-line and off while dialing
ATLx	Adjust volume (L0, low; L2, medium; L3, high)
ATX4	Wait for dial tone (modem recognizes busy signal)
S/z: x	Store phone number x in memory position n
++comma	Pause for 2 seconds
+++	Go to command state
-Enter-	End command (When on a line by itself, this command terminates dialing if the modem is dialing or waiting for a modem connection.)

* Initialization string applies to normal, MNPS, and V42 bis connections. ** The WorldPort Dual Standard 14.4 is available with noncellular or cellular capabilities.

Example: "ATDT 91-202-456-1414-Enter" tone dials an outside line, pauses 2 seconds, then dials the White House. The modem ignores the space before the number and the hyphens within it.

Example (to set up stored numbers): "AT&Z2-918001234567".

Example (to call): "ATDS=2".

Telephone coupling

When you need to connect your portable's modem to a hotel phone line, an office line, or a pay phone, you may want to check out a few phone couplers from Unlimited Systems (619-550-7330). Konexx Model 109 connects your modem to most office lines. Model 117 connects you to hotel, public, or cellular lines. All couplers are easy to install and provide the standard RJ-11 modem jack. Prices range from \$139 to \$149.

CompuServe Access Numbers

U.S. Cities	2,400 bps	9,600 bps	14,400 bps
Albuquerque, New Mexico	505-255-8626	N/A	N/A
Atlanta, Georgia	404-266-7060	404-841-0578	404-841-0578
Austin, Texas	512-444-0588	512-328-1155	512-328-1155
Baltimore, Maryland	301-832-0180	301-494-4260	301-494-4260
Boston, Massachusetts	617-482-7081	617-428-9295	617-428-9295
Buffalo, New York	718-633-0524	718-633-0562	N/A
Charlotte, North Carolina	704-331-0905	704-358-8981	704-358-8981
Chicago, Illinois	312-263-5636, 312-693-0330	312-201-0711, 312-693-4100	312-201-0711, 312-693-4100
Cincinnati, Ohio	513-771-8543	513-771-0582	513-771-0582
Cleveland, Ohio	216-781-4135	216-781-7598	216-781-7598
Columbus, Ohio	614-457-2105, 614-761-1133	614-792-0889	614-764-2957
Corpus Christi, Texas	512-882-1465	512-887-2891	N/A
Dallas, Texas	214-853-0436	214-720-9183	214-720-9183
Denver, Colorado	303-629-9145	303-595-0123	303-595-0123
Detroit, Michigan	313-535-1122	313-535-1486	313-535-1486
El Paso, Texas	915-565-0970	915-564-0380	N/A
Fort Worth, Texas	817-685-2700	817-685-2737	817-685-2737
Greensboro, North Carolina	910-292-0816	910-292-3461	N/A
Honolulu, Hawaii	808-521-6292	808-528-0430	N/A
Houston, Texas	713-650-5000	713-650-5143	713-650-5143
Indianapolis, Indiana	317-631-6824	317-638-8129	317-638-8129
Jacksonville, Florida	904-448-5624	904-730-0046	N/A
Kansas City, Missouri	816-472-1283	816-221-3817	816-221-3817
Las Vegas, Nevada	702-737-1292	702-796-4877	702-796-4877
Little Rock, Arkansas	501-378-8374	501-378-8544	N/A
Long Beach, California	310-589-5986	310-581-5788	310-581-5788
Los Angeles, California	213-629-4095	213-624-3730	213-624-3730
Memphis, Tennessee	901-323-0220	901-454-6851	901-454-6851
Miami, Florida	305-282-1543	305-282-5325	N/A
Milwaukee, Wisconsin	414-453-5132	414-453-3010	414-453-3010
Minneapolis, Minnesota	612-339-2507	612-339-1805	612-339-1805
Nashville-Davidson, Tennessee	615-380-7923	615-367-0014	615-367-0014
New Orleans, Louisiana	504-585-1200	504-585-1128	504-585-1128
New York, New York	212-608-6021, 212-988-1020	212-766-2080, 212-593-3972	212-766-2080, 212-593-3972
Norfolk, Virginia	804-855-0241	804-855-8488	N/A
Oakland, California	415-251-0910	415-251-8304	415-251-8304
Oklahoma City, Oklahoma	405-945-1018	405-942-7278	405-942-7278
Omaha, Nebraska	402-345-5012	402-345-9557	N/A
Philadelphia, Pennsylvania	215-563-1305	215-561-1634	215-561-1634
Phoenix, Arizona	602-955-1464	602-468-0285	602-468-0285
Pittsburgh, Pennsylvania	412-261-4192	412-471-8417	412-471-8417
Portland, Oregon	503-295-6000	503-274-6400	503-274-6400
Raleigh, North Carolina	919-864-5800	919-864-5848	919-864-5848
Sacramento, California	916-568-0636	916-568-0241	916-568-0241
San Antonio, Texas	512-738-8800	512-738-8645	512-738-8645
San Diego, California	619-589-4282	619-467-9508	619-467-9508
San Francisco, California	415-286-8362	415-434-1580	415-434-1580
San Jose/Santa Clara	N/A	408-727-8113	N/A
Seattle, Washington	206-242-5767	206-242-8992	206-242-8992
St. Louis, Missouri	314-241-5337	314-421-5651	314-421-5651
Toledo, Ohio	419-243-2818	419-242-5708	N/A
Tulsa, Oklahoma	918-621-1002	918-821-1036	N/A
Tucson, Arizona	602-745-8745	602-571-0207	N/A
Washington, D.C.	202-547-0061	202-547-0103	202-547-0103

International Cities	2,400 bps	9,600 bps	14,400 bps
Amsterdam, Netherlands	020-688-0085	020-688-0085	N/A
Bahamas	N/A	N/A	N/A
Brussels, Belgium	215-0530	215-0530	N/A
Hong Kong	304-1332	304-1332	N/A
Jakarta, Singapore	522-8252	N/A	N/A
London, England	490-8881	490-8881	490-8881
Madrid, Spain	577-0686	577-0686	N/A
Mexico City, Mexico	629-8101	629-8101	N/A
Montreal, Canada	879-8519	879-5826	N/A
Moscow, Russia	085-971-5101	N/A	N/A
Munich, Germany	885-30170	885-30170	N/A
Paris, France	47-89-39-40	47-89-39-40	47-89-39-40
Quebec City, Canada	647-1895	647-1895	N/A
Rio de Janeiro, Brazil	000672	N/A	N/A
Seoul, S. Korea	795-1002	N/A	N/A
Singapore	5351444	5351940	N/A
Sydney, Australia	415-1324	415-3156	N/A
Tel Aviv, Israel	131	N/A	N/A
Tokyo, Japan	5471-4790	5471-7690	N/A
Toronto, Canada	367-8122	367-8122	367-8122
Vienna, Austria	5056178	5056178	N/A

N/A—Not applicable. CompuServe is not available in this area. Call 800-848-8990 for cities not listed.

Source: CompuServe

Troubleshooting Guide:
What to Do when Your Notebook
Fails on the Road

When your portable fails on the road, you may be inclined to panic, afraid you won't be able to finish this afternoon's presentation or download your e-mail messages from your home office. If you approach the problem in a systematic manner, however, you may find that there is a simple fix. And if the problem is more involved, you can save time when talking on the phone to the vendor's service technician if you've gone through a troubleshooting routine. If no error messages have flashed on-screen, start with the obvious causes (such as an unplugged wire) and work your way to the specific one. Read the manual's diagnostic or troubleshooting section for insight into those problems that are endemic to your particular model or manufacturer. Regardless of the problem and its origin, a good start is to run a diagnostic program, such as WinSleuth Gold. Here's a run-through of the most likely causes of notebook failures and what to do about them:

Problem	Remedy
The system doesn't start or dies during operation.	- Check power plugs to make sure the system is connected to a wall outlet. (Also ensure that if outlet power is controlled by a light switch, that switch is turned on.) - Clean battery contacts or try starting up again with a second battery pack. - Make sure start-up settings are correct by checking the BIOS settings. - Restart the notebook with default settings.
The system stops during boot-up.	- Check CONFIG.SYS and AUTOEXEC.BAT to see if the files are corrupted. If they are, install backups. - If the system displays the message "Bad or missing Command Interpreter," the problem lies with the COMMAND.COM file. Install default or backup files.
The screen goes blank	The Windows screen saver or power management settings may be set to a blank screen. Check settings in the Desktop section of the Windows Program Manager.
The screen is dim.	- Check power management settings. - Increase screen brightness.
Characters are garbled	The ANSI.SYS driver in the CONFIG.SYS file or the path statement may be incorrect; add driver or DEVICE=C:\ANSI.sys to the CONFIG.SYS file.
The cursor disappears or the trackball has no effect.	Manually install mouse drivers.
The trackball works intermittently.	Open the trackball assembly, clean the ball with a tissue, close, and try the trackball again.
The hard disk does not respond.	- Boot up with a floppy disk and run CHKDSK. - Open the machine and confirm that the cables are connected. - Make sure the CMOS setup section has the correct configuration for the drive that is installed.
Hard disk operation is slow.	Reset the power management settings.
The system shuts down unexpectedly.	- Check that power management isn't shutting the system down prematurely. If the unit is hot to the touch, allow it to cool before restarting. - Check the battery and connections.
The serial or parallel ports fail to respond.	Run MSD diagnostics to see if the ports are active; if they are not, activate them in the CMOS setup menu.
The modem doesn't respond or drops out during transmission.	- If the modem is an internal device, check the socket connection and the CMOS setup menu to activate the serial-port modem. If the modem is external, check the battery or AC connection, as well as the phone-line plugs. If it is a PCMCIA device, check the socket connection. - Check the modem setup string. - Reduce the transmission rate. - Double-check the transmission parameters and flow control (hardware: RTS/CTS, software: XON/XOFF).
The battery doesn't hold a charge.	The battery may have developed a memory, a problem for nickel-cadmium cells. Perform a deep discharge by allowing it to drain fully, and then charge.

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Pentium™-66 \$3899
Pentium™-90 \$4199

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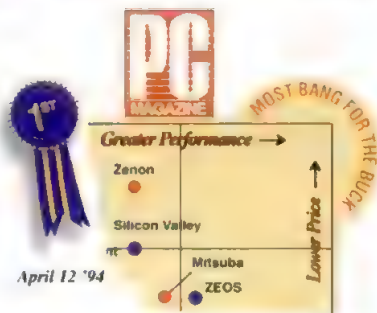
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- High-Resolution Serial Mouse
- Enhanced 101 Keyboard
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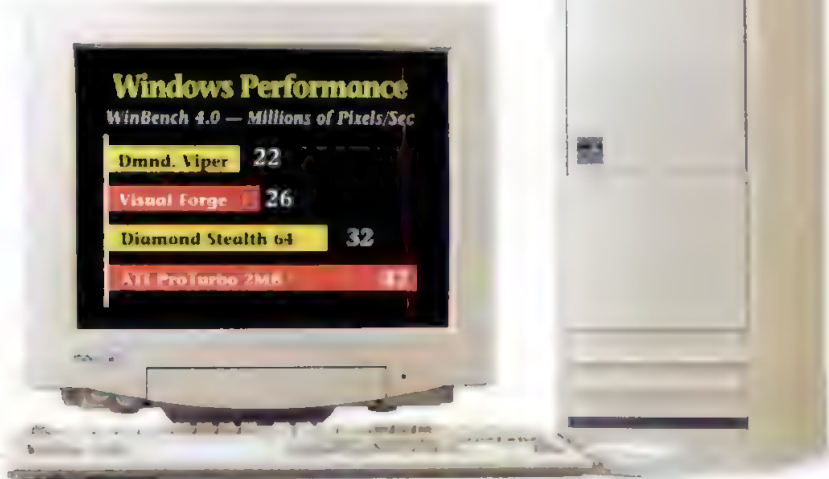
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Competitors from PC Mag, April 12 '94

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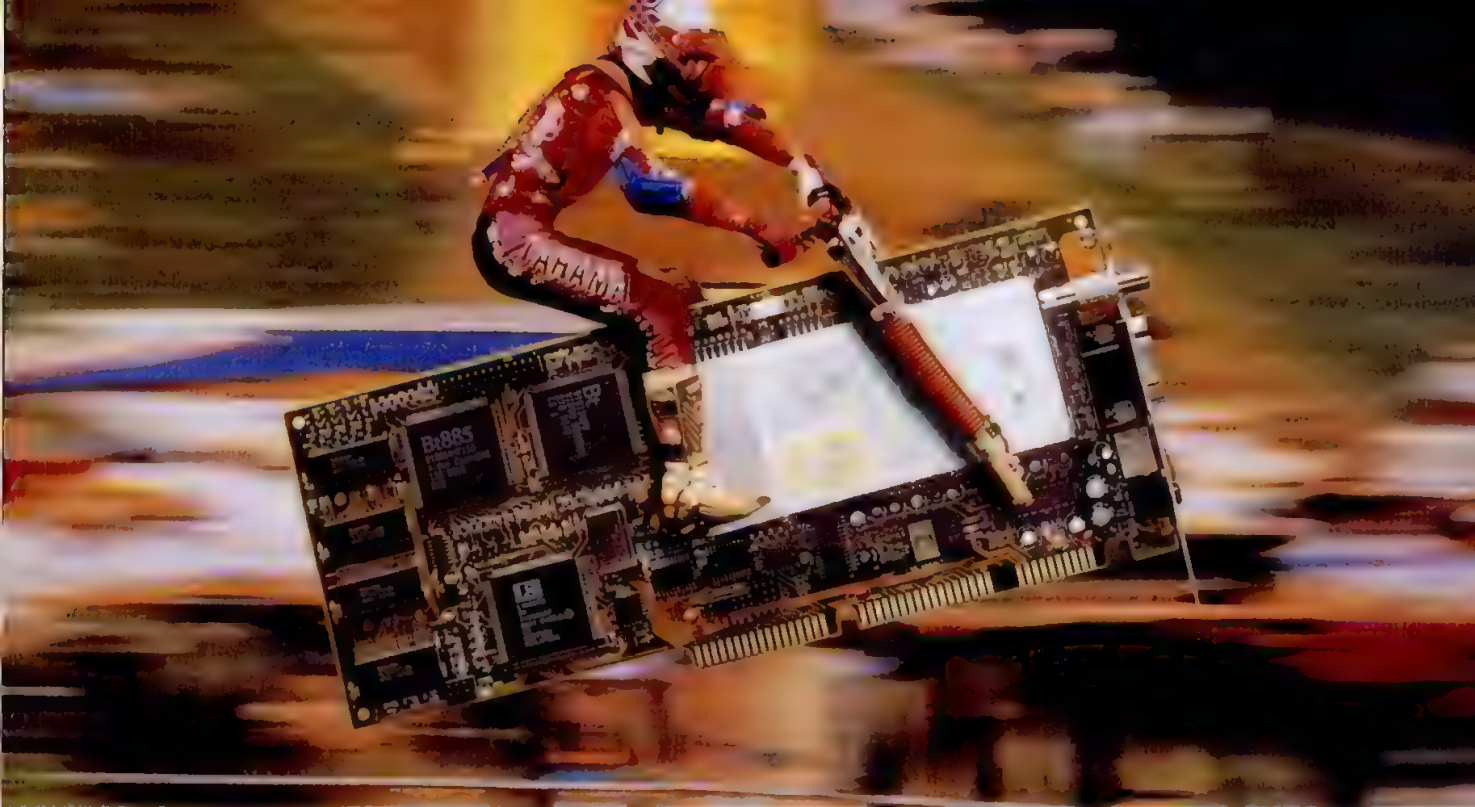
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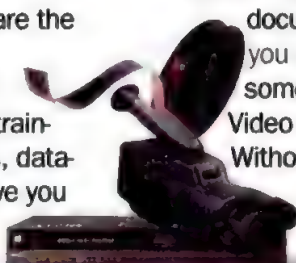
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PORTABLE MULTIMEDIA

Taking Your Show On the Road

Want to wow your audience with a snazzy presentation? These portable sound cards, speakers, and CD-ROM drives are just what you need.



As desktop multimedia moves into the mainstream, portable multimedia is rapidly becoming inevitable. And no wonder: The possibilities are irresistible. Imagine meeting a client when you're armed with a full-scale presentation—complete with music, narration, still pictures, animation, and video—all on your notebook computer. Or imagine carrying along and effortlessly searching through several encyclopedias' worth of data on CD-ROM, including your company's interactive catalog.

To run multimedia applications on the road, you'll need a notebook PC with plenty of memory (a minimum of 8MB), a big hard disk (340MB or larger), and a fast processor (a 33-MHz 486 or better). You'll also want a color screen and the ability to drive an external monitor at 800-by-600 or 1,024-by-768 noninterlaced resolution. On top of that, you'll have to add a portable CD-ROM drive, some sort of a sound-producing device, and self-amplified speakers.

Eventually, notebook PCs will come with many or all of these peripherals standard. Already, high-end notebooks are

being equipped with sound-recording and playback capabilities, although the tiny single speaker that most use won't be adequate for large presentations. By the end of this year, you'll begin to see notebooks with CD-ROM drives built in as well. Interfaces for external SCSI devices will soon appear in some laptops, making it easy to connect an external CD-ROM reader.

Another option is to take along a lightweight docking station that includes a CD-ROM drive and speakers. Some of the more portable multimedia-capable docking stations are the IBM Dock ThinkPad I for the IBM ThinkPad 750/755 series; the NEC Versa Docking Station (also sold as the AT&T Safari Docking Station) for the AT&T Safari 3180, the AT&T Safari 3181, or the NEC Versa; and Texas Instruments's new TI TravelMate Desktop Intelligent Docking System for TI's 4000 and 4000E series.

For more information about multimedia-equipped

By M. David Stone

notebooks and docking stations, see our cover story "Notebooks: The Spectrum of Choice" and the accompanying sidebar "Docking Stations: Quick Connections."

WHAT WE TESTED

While lightweight, compact design was a general guideline for the portable CD-ROM drives, sound devices, and speakers we tested, we did not specify maximum dimensions and weights; instead, we let vendors supply equipment that they considered roadworthy. Nor did we require that products run on battery power, since most presentations are made in rooms with electrical outlets.

Our only specific criterion was that a product had to connect via a parallel or a PCMCIA port and work with our portable test-bed, an NEC Versa E Series DX4/75. We chose the NEC Versa for its 75-MHz Intel DX4 microprocessor, active-matrix color display, and 340MB hard disk—a combination that's more than adequate for running multimedia applications. We also selected the NEC Versa because in our past tests its two PCMCIA Type II slots have demonstrated broad compatibility with PCMCIA peripherals.

We received 1 PCMCIA and 5 parallel-port sound devices, 11 sets of powered speakers, and 2 CD-ROM drives. These products are just the first few of a wave of portable multimedia devices that will appear by year's end.

In the accompanying table "CD-ROM Drives," we have also included information for four external CD-ROM drives that we tested for the feature "CD-ROM Drives: Going Mainstream" (February 22, 1994) plus the Toshiba TXM-3401P, a portable version of the XM-3401B, which we also reviewed in that issue. These four drives are heavier and bulkier than the two products we examined specifically for this feature, but they can be connected to a laptop via a PCMCIA SCSI adapter or a parallel-to-SCSI adapter.

GENERAL OBSERVATIONS

Can you really take multimedia on the road? The short answer is yes—if you're



- *Speakers*.....**Altec Lansing ACS 50**
AppleDesign Powered Speakers
- *Sound devices***No Editors' Choice**
- *CD-ROM drives***No Editors' Choice**

Finding the right components to put the punch in your multimedia presentation won't be easy. CD-ROM drives with parallel port connections are poor performers when

it comes to playing back multimedia files, and the sound quality of the parallel port and PCMCIA-based sound devices we reviewed was audibly lacking. While both portable SCSI CD-ROM drives we tested performed adequately, neither stood out as an obvious Editors' Choice.

Portable speakers offer a larger set of options. The Altec Lansing Multimedia

ACS 50 speakers (\$100) earn an Editors' Choice for providing the best sound reproduction in the under-3-pound weight class; they're an excellent choice if portability is paramount and you need to present to only two or three people at a time.

If you're willing to lug along a lot more weight, consider our second Editors' Choice, the \$179 AppleDesign Powered

willing to accept some compromises. While today's notebooks offer processing power, memory, storage capacities, and displays that can compete with those of desktop systems, the portable sound devices we tested did not approach traditional sound cards in sound quality or features. In part, that's because most of the portable sound solutions available today are geared more toward voice applications than high-quality audio reproduction. None of the products we tested compared well with a typical ISA sound board. For speakers, too, portability means noticeable compromises in sound quality and loudness.

If you have to make no-compromises presentations, you'll need to lug along a 10-pound-plus, AC-powered system such as the Dolch P.A.C. 586 or the Toshiba T6600, both of which have ISA slots that can accept real sound cards.

Given the lack of expansion-bus slots in a typical portable, you are left with a choice among serial, parallel, and PCMCIA interfaces. The serial interface is often required for an external pointing device (since built-in pointing devices don't allow much freedom of movement during a presentation). Unfortunately, we found that neither the parallel port nor a PCMCIA slot is an ideal way to connect

more than one multimedia device.

If your notebook doesn't provide a PCMCIA slot, you'll have to use a single parallel port to connect both a CD-ROM drive and a sound device. However, even if one or the other offers a pass-through connector so that you can physically attach both, there's no guarantee that they will coexist peacefully.

In testing parallel sound devices with a Micro Solutions backpack double-speed CD-ROM drive (which also connects to the parallel port), we encountered all kinds of problems. In the worst cases, the combination wouldn't work at all or would play part of a CD-ROM sound file and then spontaneously and inexplicably stop. In the best cases, the combination played sound without difficulty but refused to play video clips.

Using the parallel port introduces another problem: poor performance. As we found in our February 22, 1994, look at CD-ROM drives, playing AVI (audio video interleaved) clips from a parallel-port CD-ROM drive invariably resulted in choppy video and even audio dropouts. Adding a second device to the parallel port only worsens the problem.

PCMCIA slots can skirt some of the problems associated with parallel ports, but they also introduce hassles of their own. As we've found from extensive testing of PCMCIA devices, you can't count on getting two to work together, and in some cases you may have trouble getting

Our Contributors: M. DAVID STONE is a contributing editor of *PC Magazine*. LEON ERLANGER was the associate editor in charge of the story, and MICHAEL J. ZULICH was the project leader.

Speakers from Apple Computer. The 6.3-pound (with AC adapter) Apple-Design speakers were the only ones loud enough for presentations to a group of a dozen or more.

Among sound boards, the best sound quality came from the Video Associates AudioPort (\$295), though this board lacks MIDI capabilities. If you need first-class sound, look to the AC-powered Dolch or Toshiba luggables that include full-size 16-bit ISA slots for sound cards or consider one of the new portable multimedia docking stations discussed in the sidebar "Docking Stations: Quick Connections" within our cover story "Notebooks: The Spectrum of Choice." In the next few months you should see more multimedia-capable notebooks on the market.

even one PCMCIA device to work. The current state of PCMCIA is best described as converging on a standard rather than actually being a standard. Avoid trouble by calling the manufacturer before you purchase to confirm that a PCMCIA card will work with your system—and make sure you're protected by a money-back guarantee.

Note, too, that PCMCIA drivers can take up more memory than you might be willing to spare. In our tests, we had trouble freeing enough conventional memory to run the game programs we used for our DOS compatibility tests. Even after eliminating all drivers and TSRs that we didn't absolutely need—including SmartDrive—and then running DOS's MemMaker utility to optimize memory usage, we still didn't have enough memory to run Virgin Games' *The Seventh Guest* and Activision's *Return to Zork*, among others.

The one PCMCIA sound card we tested, New Media Corp.'s WAVjammer, worked fine with a PCMCIA SCSI card from Apex Data. If you want to play it safe, however, get one PCMCIA device and one parallel device. For the best results, choose a parallel-port sound device and a SCSI-2 CD-ROM drive plugged into a PCMCIA SCSI-2 adapter.

HOW WE TESTED

We began our testing with sound devices. We played each through a set of Altec Lan-

sing ACS 300 desktop speakers, which have consistently impressed us with their high-fidelity sound reproduction. We tested with two CD-ROM drive subsystems: Media Vision's Reno CD-ROM drive connected to an Apex Data ApexSCSI PCMCIA-to-SCSI adapter and the Micro Solutions double-speed backpack CD-ROM drive connected directly to the parallel port.

We listened to an assortment of musical selections, taking care to include both quiet and loud passages and to cover the range from low to high frequencies. For each device that could record sound, we recorded passages from an audio CD and then played them back. We also recorded and replayed a voice passage, listened to MIDI files, and did some cursory tests for Ad Lib and Creative Labs Sound Blaster compatibility.

One fact was immediately obvious, even to casual listeners: None of these sound devices can record or play back truly CD-quality audio. As a result, we relied on qualitative tests based on the judgment of the human ear rather than the quantitative audio tests we usually use

for sound boards claiming CD quality.

We concluded that Video Associates Labs' \$295 MicroKey/AudioPort offered the cleanest, highest quality sound in the group, so we used the MicroKey/AudioPort for testing the CD-ROM drives and speakers. We ran both qualitative and quantitative performance tests on the CD-ROM drives. For the qualitative tests, we used assorted CD-ROMs to play various audio and video files, looking for any obvious, immediately perceptible difference in playback quality. To quantify these differences, we ran the same set of tests that we used in our February 22, 1994, story on CD-ROM drives. These tests measure throughput for sequential and random reads using several block sizes and, using Microsoft's VidTest, record CPU utilization, dropped video frames, and breaks in audio continuity. For further details on these tests, see "How We Tested" on page 132 of our February 22, 1994, issue.

PORTABLE SPEAKERS

After finding no noticeable difference in sound quality or playback smoothness

HIGHLIGHTS

Portable Multimedia

TO EQUIP YOUR NOTEBOOK PC for multimedia, you'll generally need to add a CD-ROM drive, a sound device, and self-amplified speakers.

PORTABLE SOUND DEVICES don't offer the same features or sound quality as standard sound boards; many are suitable only for tasks like voice annotation and playback, not for reproducing high-quality audio. Most portable sound devices connect to PCs via a parallel port, although New Media Corp. sells a PCMCIA sound card. More PCMCIA sound cards will be shipping by year-end.

PORTABLE CD-ROM DRIVES work best when they're SCSI models connected via a PCMCIA-to-SCSI adapter. Some units connect via a parallel port, but their throughput is so limited that smooth video and uninterrupted audio are virtually impossible.

THE IMPACT OF YOUR PRESENTATION

depends largely on the quality of your speakers. As a rule, we found that larger, heavier speakers offered higher-quality sound reproduction. For making presentations to two or three people, a 3-pound speaker set may be enough; when addressing a larger group, expect to carry between 5 and 10 pounds.

INTEGRATING PORTABLE MULTI-

media products can be a hassle. Don't expect success if you connect both a CD-ROM drive and a sound device to one parallel port using a pass-through connector. A far better solution: Use a PCMCIA slot for a SCSI adapter to run the CD-ROM drive, and use the parallel port for the sound adapter. As more notebooks integrate sound capabilities and, eventually, CD-ROM drives, integration issues will become less critical.



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► **SUMMARY OF FEATURES**

Portable Speakers

PC MAGAZINE | PC MAGAZINE
BUYERS' GUIDE BUYERS' GUIDE

Products listed in alphabetical order

■ = YES □ = NO

	Advent Powered Partners 22	Altec Lansing Multimedia Altec Computer Speaker Subwoofer ACS 150	Altec Lansing Multimedia Altec ACS 50	Apple Computer Inc. AppleDesign Powered Speakers	Apple Computer Inc. AppleDesign Powered Speakers II	Labtec Enterprises Inc. Labtec CS-150	Labtec Enterprises Inc. Labtec CS-180	Labtec Enterprises Inc. Labtec CS-550
List price	\$109.00	\$150.00	\$100.00	\$179.00	\$85.00	\$39.95	\$49.95	\$59.95
Dimensions for each unit (HWD, in inches)	5.5 x 3.8 x 3.5	5.5 x 7 x 10.1	5.2 x 1.9 x 2.8	9.3 x 4.6 x 4.3	8.8 x 4.2 x 6	5 x 3.4 x 3.6	5.3 x 3.4 x 3.4	6.3 x 3.8 x 3.7
Travel weight	3 lbs. 3 oz	9 lbs.	2 lbs. 8 oz.	8 lbs. 5 oz.	3 lbs. 14 oz.	2 lbs. 2 oz.	2 lbs. 2 oz.	2 lbs. 6 oz
Number and type of batteries	N/A ①	N/A ①	N/A ①	N/A ①	N/A ①	4 C	8 AA	4 C
Amplifier output (watts per channel)	3	18	4.5	12.5	7	3.6	4	4
Number of stereo input jacks	1	1	2	1	2	1	1	1
Volume control	Master	N/A ②	Master	Master	Master	Separate control on left and right speakers	Separate control on left and right speakers	Master
Warranty	2 years	1 year	1 year	1 year	1 year	1 year	1 year	1 year
Telephone number for inquiries	800-323-0707	800-648-6663	800-648-6663	800-538-9696	800-538-9696	Contact retailer	Contact retailer	Contact retailer
Number to circle on reader service card	529	530	530	531	531	532	532	532

N/A ① Not applicable. This product does not use batteries. N/A ② Not applicable. This product is an auxiliary bass speaker, volume control is on main speaker.

between the CD-ROM drives, we arbitrarily chose Media Vision's Reno drive for testing speakers.

The 11 speaker sets we tested fell into three weight categories. Five speaker sets came in at 2.5 pounds or less (with batteries and AC adapters): the Altec Lansing Multimedia ACS 50 (\$100); Labtec Enterprises' CS-150 (\$39.95), CS-180 (\$49.95), and CS-550 (\$59.95); and Sony Corp.'s SRS-PC20 (\$39.95). Weighing between 3.0 and 4.5 pounds were Advent's Powered Partners 22 (\$109), Apple Computer's AppleDesign Powered Speakers II (\$85), and Sony Corp.'s SRS-58PC (\$129.95). The \$179 AppleDesign Powered Speakers and the \$149 Yamaha YST-M10 each weighed more than 5 pounds.

The final speaker we tested, the Altec Lansing Multimedia Computer Speaker Subwoofer ACS 150, is a special case. The subwoofer is designed to supplement the deep-bass response (35 to 250 Hz) of any other pair of speakers. Although it will add depth to your presentations, its 9-pound weight may be too much to tote for most purposes.

We enlisted a panel of audiophiles to compare speakers by listening to a selection of CDs, MIDI files, and .WAV files. Our panel agreed that the best speakers in each weight class were outperformed by even the lowest-quality speakers in the next class. As

weight increased, the speakers' loudness grew, bass response became fuller, and high-frequency tinniness was reduced.

The speakers weighing 2.5 pounds or less are rated at no more than 4.5 watts per channel and are suitable only for presentations to just two or three people. In

Advent speakers weren't far behind the Sony speakers.

Our panel was split on the heavyweights: Some preferred the 12.5-watt-per-channel Apple speakers for their slightly fuller bass, and others preferred the 10-watt-per-channel Yamaha speakers for their somewhat crisper higher-frequency sound. The Apple speakers include a balance control, however, which gives them an edge since you can adjust volume independently to achieve the best stereo effect. If you plan to give a presentation in a moderate-size conference room, the choice you'll need to make is between these two.

Our conclusion: Your choice in portable speakers is generally between small, lightweight speakers with minimal sound quality, and larger, heavier speakers with higher quality.



Top row, from left: Video Associates MicroKey/AudioPort, VocalTec's The CAT, New Media WAVjammer. Bottom, from left: DSP Solutions' Port-Able Sound Plus, Logitech's AudioMan, InterActive's SoundXchange Model B.

this category, our panel was unanimous in choosing the Altec Lansing ACS 50 as the winner for best sound quality.

At the next step up, the AppleDesign Powered Speakers II nosed out Sony's SRS-58PC—not so much because of better sound quality, but because its built-in 7-watt-per-channel amplifiers put out noticeably more volume than the 3-watt-per-channel Sony units. The 3-watt-per-channel

port. Three of the five parallel devices—DSP Solutions' \$198 Port-Able Sound Plus, InterActive's \$229 SoundXchange Model B, and Logitech's \$179 AudioMan—provide a pass-through connector for plugging in another parallel device. The two without pass-through connectors are the Video Associates MicroKey/AudioPort (\$295) and VocalTec's The CAT (\$179). You can buy the SoundXchange without a parallel pass-

SOUND DEVICES

We tested six sound devices, five of which plug into a parallel

HARDWARE

Portable Multimedia

Sony Electronics Inc. Sony SRS-PC20	Sony Electronics Inc. Sony SRS-50PC	Yamaha Corp. of America Yamaha YST-M10
\$39.95	\$129.95	\$149.00
5.4 x 3.5 x 3.9	7.2 x 3.2 x 5	8.8 x 3.9 x 6.3
1 lb. 11 oz.	4 lbs. 3 oz.	5 lbs. 14 oz.
4 AA	8 C	N/A ①
1	3	10
1	1	1
Master	Separate control on left and right speakers	Master
1 year	1 year	1 year
201-368-9272	201-368-9272	714-522-9937
533	533	534

through for \$169. The CAT was the only one that had a problem with the NEC Versa's parallel port set for enhanced bidirectional operation; it worked fine with the port set to unidirectional.

The lone PCMCIA sound device we tested was New Media Corp.'s WAVjammer, a \$399 PCMCIA Type II card.

PCMCIA sound cards from DSP Solutions, I/O Magic, Media Vision, and Turtle Beach Systems had been announced but were not yet shipping as we went to press.

Unfortunately, none of the tested sound devices offers all the capabilities necessary to make full use of multimedia applications. Two of them—the SoundXchange and The CAT—don't even offer a line-in jack for plugging in a CD-ROM or other music source.

The three devices that we found to be passable for music—if barely—were the MicroKey/AudioPort, the WAVjammer, and the Port-Able Sound Plus. Even these lacked sound quality, though: When monitoring or recording music from the only output available on either of the portable SCSI CD-ROM drives we tested, the first two suffered from an annoying, rhythmic, low-frequency background sound that is quite noticeable during quiet moments—especially if you're using good speakers at high volume. The noise became audible as soon as CD-ROM drivers were loaded. According to New Media, the problem is related to an impedance mismatch be-

tween the headphone output of the CD-ROM drives and the line-in jack on the sound device.

This leaves the MicroKey/AudioPort as the only sound device appropriate for recording music with any modicum of fidelity. Unfortunately, the MicroKey/AudioPort has no MIDI capabilities. The AudioMan, the Port-Able Sound Plus, and the WAVjammer can play MIDI files using FM synthesis; the Port-Able Sound Plus and the WAVjammer are notable for providing a reasonably rich, full MIDI sound. None of the devices we tested can record MIDI, although that's not a necessity for portable presentations.

All six devices can play 16-bit, 44.1-kHz sound files, but only the MicroKey/AudioPort and the WAVjammer can record 16-bit, 44.1-kHz sound. The other devices are limited to an 11-kHz sampling rate, with the AudioMan and the SoundXchange offering a maximum 8-bit sampling size, The CAT offering 13-bit sampling, and the Port-Able Sound Plus offering 14-bit sampling.

Most of the products are monoaural, too: Only the WAVjammer and the Port-



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NETWORKS THAT GO THE DISTANCE

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Able Sound Plus play back in stereo, and only the WAVjammer can record in stereo.

Also, don't count on playing games or running DOS-based multimedia packages with most of these devices. The Port-Able Sound Plus and the WAVjammer claim Ad Lib compatibility, but only the Port-Able Sound Plus claims Creative Labs Sound Blaster compatibility in DOS. (The WAVjammer claims Sound Blaster compatibility but only in a DOS window within Microsoft Windows.) Furthermore, between PCMCIA support drivers, CD-ROM drivers, and sound drivers, we couldn't free up enough memory to run most of our usual compatibility test programs. Only the Port-Able Sound Plus was able to work with any DOS games.

All the products worked perfectly under Windows except the SoundXchange, which suffered from rapidly varying volume levels when playing back AVI files. InterActive pointed out that the SoundXchange was designed for voice applications and doesn't have the horsepower to process interleaved audio.

If you need to play back only files recorded on other systems and insist on reasonably high-quality sound, the Micro-

Key/AudioPort, the Port-Able Sound Plus, and the WAVjammer will do. If you need to record music from CDs as well, the MicroKey/AudioPort is the only real choice. For MIDI playback, try the Port-Able Sound Plus or the WAVjammer.

CD-ROM DRIVES

We tested two CD-ROM drives for this story, both of which are designed for

portability. The \$349 Media Vision Reno weighs less than 3 pounds, complete with battery back and AC power cable. The \$415 NEC MultiSpin 3Xp, which doesn't have a battery option, weighs just a bit less than 3 pounds 1 ounce. Both are housed in relatively small cases.

The MultiSpin 3Xp, a triple-speed drive, performed slightly better than the Media Vision Reno double-speed drive

► SUMMARY OF FEATURES

Portable Sound Devices

Products listed in alphabetical order ■ = YES □ = NO	DSP Solutions Inc. DSP Port-Able Sound Plus	InterActive InterActive SoundXchange Model B	Logitech Inc. Logitech AudioMan	New Media Corp. New Media WAVjammer	Video Associates Labs Inc. Video Associates MicroKey/Audioport	VocalTec Inc. VocalTec's The CAT
List price	\$198	\$229	\$179	\$399	\$295	\$179
Travel weight	1 lb. 13 oz.	2 lbs. 6 oz.	13 oz.	3 oz.	13 oz.	10 oz.
Number and type of batteries	8 AA	N/A ①	2 AA	N/A ①	1 9-volt	1 9-volt
Interface	Parallel	Parallel	Parallel	PCMCIA	Parallel	Parallel
Maximum sampling size for recording/playback	16-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	16-bit, 16-bit	16-bit, 16-bit	13-bit, 16-bit
Maximum sampling rate for recording/playback (kHz)	11, 44.1	11, 44.1	11, 44.1	44.1, 44.1	44.1, 44.1	11 at 8-bit, 8 at 13-bit; 44.1
Sound chip	TI C25325	Intel 8751	AudioMan	Yamaha OPL 3	MSM 6388	VocalTec
DSP	■	□	□	■	■	■
Synthesizer type	FM	N/A ②	FM	FM	N/A ②	N/A ②
Line-in/Line-out connector	■ ■	□ ■	■ ■	■ ■	□ ■	□ ■
Separate microphone connector/Built-in speaker	□ □	□ ■	□ ■	□ □	■ □	■ □
Warranty coverage	90 days	1 year	Lifetime	Lifetime	1 year	1 year
Telephone number for inquiries	415-494-8086	800-292-2112	800-231-7717	800-227-3748	800-331-0547	201-768-9400
Number to circle on reader service card	523	524	525	526	527	528

N/A ①—Not applicable: This product does not use batteries. N/A ②—Not applicable: This product is not capable of FM or wavetable synthesis.

► SUMMARY OF FEATURES

CD-ROM Drives

Products listed in alphabetical order
■ = YES □ = NO

	CD Technology Inc. CD Porta-Drive Model T3401	Liberty Systems Inc. Liberty 115CDP	Media Vision Inc. Media Vision Reno	Micro Solutions Inc. Micro Solutions backpack (standard speed)	Micro Solutions Inc. Micro Solutions backpack (double speed)	NEC Technologies Inc. NEC MultiSpin 3Xp	Toshiba America Information Systems, Inc. Toshiba TXM-3401P*
List price	\$1,050	\$838	\$349	\$449	\$499	\$415 (estimated)	\$630
Case dimensions (HWD, in inches)	2.8 x 8.8 x 9.4	1.8 x 6.9 x 9.5	1.4 x 6 x 10.3	2.3 x 6 x 10.5	2.3 x 6 x 10.5	2.2 x 6.1 x 10.1	2.1 x 8.7 x 9.5
Travel weight	3 lbs. 6 oz.	4 lbs. 3 oz.	2 lbs. 13 oz.	4 lbs. 2 oz.	4 lbs. 2 oz.	3 lbs.	3 lbs. 14 oz.
Number and type of batteries	N/A	N/A	4 AA	N/A	N/A	N/A	1 nickel cadmium pack
AC power supply	External	Internal	External	External	External	External	External
Interface	SCSI-2	Parallel/SCSI	SCSI-2	Parallel	Parallel	SCSI-2	SCSI-2
Mechanism model	Toshiba XM-3401B	Toshiba XM-3401B	Matsushita (custom)	Mitsumi CMRC-FX001	Mitsumi CMRC-FX001	NEC proprietary	Toshiba XM-3401
Claimed data-transfer rate (kilobytes per second)	330	330	306	150	300	450	330
Average access time (milliseconds)	200	200	180	280	250	250	200
Buffer size (kilobytes)	256	256	64	128	32	256	256
Supports audio CDs	■	■	■	■	■	■	■
Supports single-session and multisession Photo CD	■	■	■	■	■	■	■
Warranty coverage	1 year	1 year	1 year	1 year	1 year	2 years	1 year
Telephone number for inquiries	408-752-8500	408-983-1127	800-845-5870	800-890-7227, ext. 200	800-890-7227, ext. 200	800-388-8888	714-457-0777
Number to circle on reader service card	517	518	519	520	520	477	469

* This is the portable version of the Toshiba XM-3401B drive we reviewed in our February 22, 1994 issue. N/A—Not applicable: This product does not use batteries.

in terms of raw throughput. The MultiSpin 3Xp, however, was able to reach its rated 450-kilobyte-per-second throughput only when connected to a desktop PC with NEC's own 16-bit ISA-bus SCSI adapter. Interactions among the PCMCIA and SCSI drivers in the notebook apparently prevented the drive from reaching its full potential in our tests.

Both the Media Vision Reno drive and the MultiSpin 3Xp handled most multimedia playback tasks without difficulty. When playing back a 24-bit-color, 160-by-120-pixel AVI clip compressed with Intel's Indeo codec, the Media Vision Reno skipped some video frames and momentarily dropped audio a few times. The MultiSpin 3Xp showed a relatively high 67 percent CPU utilization on our most demanding AVI clip (an 8-bit-color, 320-by-240-pixel file) but did not drop any frames. In qualitative testing, differences between the two were imperceptible.

In fact, virtually any external CD-ROM drive will suffice for portable presentations if you're near an electrical outlet. We've included specs for a few of

these drives in the Summary of Features accompanying this story. These drives, which weigh upward of 3 pounds not including AC adapters, are all somewhat heavier than the Media Vision Reno and

If you're ready to take the plunge into portable multimedia, first try some of the newer laptops with integrated sound capabilities.

the MultiSpin 3Xp. Additionally, both Micro Solutions drives are parallel-port drives, not SCSI drives: In our previous tests, each dropped 80 to 90 percent of the video frames in a variety of AVI clips.

ROUNDING IT OUT

If you're interested in group presentations, you may want to look at LCD presentation panels, which sit on an overhead

projector and project the image from your computer onto a projection screen or wall. We will report on color LCD projection panels in an upcoming issue.

LCD projection panels are expensive: Color models start at about \$3,000. A lower-cost alternative is a scan converter, which converts a VGA output into NTSC signals that can be viewed on any U.S. television set.

If you're ready to take the plunge into portable multimedia today, first try some of the newer laptops with integrated sound capabilities; if these don't meet your needs, think about either a PCMCIA or a parallel-port sound device. For high-impact presentations, you'll need a high-end ISA sound board like the Turtle Beach MultiSound installed in a luggable PC such as the Dolch P.A.C. 586 or the Toshiba T6600.

The external CD-ROM drive you buy should be SCSI (if you can't get a portable with SCSI installed, it should run off a PCMCIA-to-SCSI adapter). And your speakers should be the highest quality (which unfortunately means heaviest) that you can bear to take along. □

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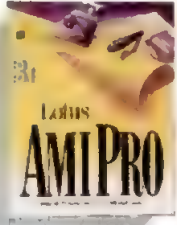
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[illegible]

The diagram illustrates the Ami Pro 3.1 software interface. At the top, the title bar reads "Ami Pro 3.1". Below it is a menu bar with options: "File", "Page", "Format", "Tools", "Windowing", and "Help". A toolbar contains various icons for file operations (New, Open, Save, Print, Find, Copy, Paste, Undo, Redo, Cut, Paste) and editing (Find, Copy, Paste, Undo, Redo, Cut, Paste). The main window displays a document titled "PROF". The status bar at the bottom indicates "Page 1 of 1" and "Line 1 of 1". A large, hand-drawn box labeled "Notes" is overlaid on the right side of the window.

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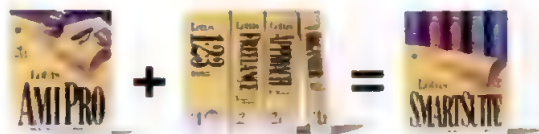
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PORTABLE PRINTERS

No Desk Necessary

We review five compact, lightweight printers you can tuck into the corner of your desk—or take on the road along with your notebook.

By Bruce Brown

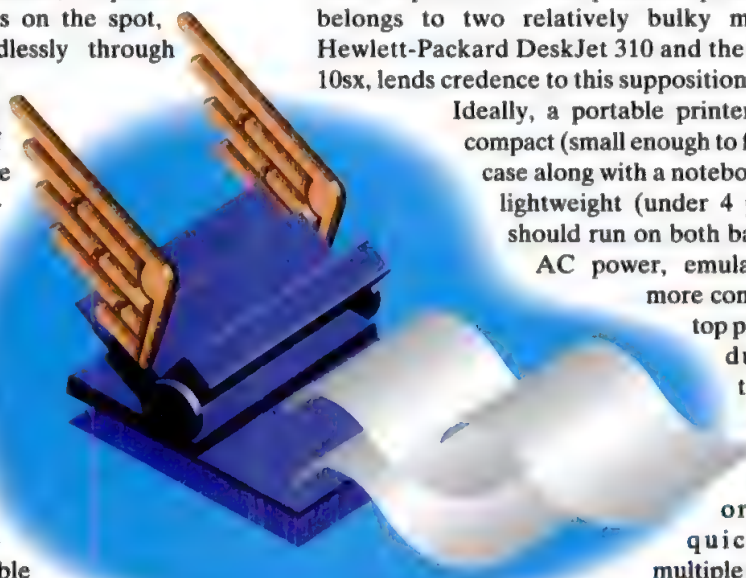
Sure, a portable printer would help round out your mobile office. You could make last-minute changes to presentations, update contracts on the spot, and stop scrolling endlessly through spreadsheets too big for your notebook's puny screen. But the fantasy of carrying along a portable printer often spells aggravation in real life—once you consider the additional weight, bulk, and extra cables and consumables that you have to carry along with your notebook.

That's largely why portable printer sales haven't mirrored the tremendous surge in portable PC sales over the past few years. BIS Strategic Decisions, a research firm in Norwell, Massachusetts, estimates that about 387,000 portable printers (which it defines as under 10 pounds and battery powered) were shipped in the U.S. in 1993, compared with 395,000 in 1992. Although BIS expects the market to grow—to 500,000 units this year and nearly 600,000 next year—many of those printers won't spend a day on the road.

Instead, says BIS, printers

ostensibly designed to be portable are selling primarily because they produce high-quality output at low prices yet require minimal desk space. The fact that 70 percent of the portable printer market belongs to two relatively bulky models, the Hewlett-Packard DeskJet 310 and the Canon BJ-10sx, lends credence to this supposition.

Ideally, a portable printer would be compact (small enough to fit in a briefcase along with a notebook PC) and lightweight (under 4 pounds). It should run on both batteries and AC power, emulate one or more common desktop printers, produce sharp text and graphics in black and in color, perform quickly, feed multiple pages automatically, and have low consumable costs. But the truth is, there's no portable printer sold today that can do it all.



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REVIEW CRITERIA

To be included in this year's roundup, a printer had to offer a battery option or weigh under 10 pounds (with a sheet feeder). It had to support a standard PC printer emulation (Epson FX or LQ series, IBM Proprinter, HP PCL or Adobe PostScript) and be shipping in quantity by April 30, 1994.

Portable Printers

We did not reexamine those printers that we had reviewed previously but were still shipping; this eliminated the Manesmann Tally MobileWriter and MobileWriterPS, as well as Lexmark International's IBM Portable Printer 5183. The Kodak Diconix 701, which won an Editors' Choice last year ("Portable Printers: Steppin' Out," August 1993), is no longer on the market.

Each of the five printers that we reviewed illustrates at least some of the compromises that portability entails. Atlantic Technologies' ATI SlimWriter, \$499 list price, weighs only 3.4 pounds equipped for the road and unfolds for traveling to a mere 1-inch thick. But its thermal fusion printing technology is slow and imposes an extremely high per-page cost. The \$349 Canon BJ-10sx ink jet printer produces crisp output at a fair speed but it requires an awkward sheet feeder to handle more than one page at a time. The \$399 Citizen Notebook Printer II, a thermal fusion model from Citizen America Corp., takes a middle-of-the-road approach: Its output and speed are good though they're not outstanding, and its main drawback is the short (50-page) life of its ribbon cartridges.

The \$379 HP DeskJet 310 Printer generates output that rivals any desktop ink

jet printer for only 2 cents per page. On the other hand, it can't handle multiple pages without a bulky cut-sheet feeder, and at almost 6 pounds with an AC adapter, it's no featherweight. The Seikosha LT-20XL, a \$549 dot matrix printer, has a convenient, integrated 50-sheet paper tray but produces rough-looking output that isn't adequate for presentation to customers.

*Each of the five printers
that we reviewed
illustrates at least some
of the compromises that
portability entails.*

One more printer, the Olivetti JP 50, would have met our filter except that it was not shipping in the U.S. by our deadline. We examine it in the sidebar "Olivetti JP 50: Waiting in the Wings."

WHAT'S NEW

Changes in the portable printer market in the past year have been mostly incremental, except for the addition of standard color capability to Hewlett-Packard's

popular ink jet line and the Citizen Notebook Printer II.

This year, all of the reviewed printers can operate both on battery and AC power.

Print quality has improved somewhat—especially among ink jets, the leaders in print quality. Although the HP DeskJet 310 had the second-highest rated resolution—300 dots per inch versus 360 dpi for the ATI SlimWriter, Canon BJ-10sx, and Citizen Notebook Printer II—its output was clearly superior to the competition's. Two other ink jet printers, the Olivetti JP 50 and the Canon BJ-10sx, generated the next-best results.

Output from the ATI SlimWriter and Citizen Notebook Printer II thermal fusion printers was adequate. Results from the dot matrix Seikosha LT-20XL were poor, with jagged text and severe banding and streaking on graphics.

DIFFERENTIATING FEATURES

The HP DeskJet 310 is the runaway leader when it comes to performance. It placed first in every one of our speed tests except the CorelDRAW test (where it came in second). The ATI SlimWriter, at 22 characters per second, was the slowest at printing text; the ATI SlimWriter and Citizen Notebook Printer II, at 0.3 graph-

HIGHLIGHTS

Portable Printers

PC LABS TESTED six portable printers weighing under ten pounds; all of them supported a battery option. The three ink jet printers offered superior print quality, quiet operation, and low per-page costs—as little as 2 cents per page for the HP DeskJet 310 printer. The best argument for the only dot matrix unit we tested: printing multipart forms. Thermal fusion technology, which is similar to the thermal dye transfer technique used by high-end color printers, offers moderate print quality but at a slow speed and high per-page costs: 16.5 cents for the Citizen Notebook Printer II and 52 cents for the ATI SlimWriter when using single-strike ribbons.

THE HP DESKJET 310 was the runaway performance leader, churning out text and graphics in Windows at twice the competition's speed or more. The ATI SlimWriter and Seikosha LT-20XL managed only 20 to 30 characters per second for text, which translates into over a minute for a double-spaced page.

THE MOST CONVENIENT printer to carry and use was the ATI SlimWriter, which unfolds into a one-inch-thick, 9-by 11-inch shape that fits comfortably into a briefcase. At 3.4 pounds including batteries and adapter, it also tied with the Citizen Notebook Printer II as the lightest printer.

PAPER HANDLING can be a problem for portable printers. Most models require a sheet feeder attachment to handle more than one sheet at a time. Exceptions: The Seikosha LT-20XL, which has a built-in 50-sheet paper tray and the Olivetti JP 50, which has foldout arms. The Citizen Notebook Printer II can handle five pages without its feeder and can print heavy paper via a bottom feeder.

COLOR is an option for the HP DeskJet 310 and the Citizen Notebook Printer II. Both produced excellent color output, though printing wide areas of solid color caused paper output from the HP to crumple slightly.

ics pages per minute, were the slowest at printing graphics in Windows.

The Seikosha LT-20XL boasts the best paper handling of the bunch and, thanks to its integrated slide-in 50-sheet paper tray—by far the most convenient. But the tradeoff is the largest volume and highest weight of the tested models.

The Citizen Notebook Printer II and the Olivetti JP 50 are the only other printers that can print multiple pages without a sheet-feeder attachment. Rated to feed a maximum of five pages at a time, the Citizen printer handled as many as 11 sheets in our testing. It was also the smallest tested printer and tied for the lightest.

Cost per page varies dramatically among the tested units, from a low of 2 cents per page for the HP DeskJet 310 to a high of 52 cents per page for the ATI SlimWriter (with single-use ribbons). High per-page costs often indicate that a printer consumes ink or ribbons rapidly. The SlimWriter, for instance, can print only about nine text pages, each containing 2,500 text characters, with a single-strike ribbon cartridge before a new one is required. It prints up to 120 pages per multistrike cartridge. The DeskJet 310 can handle 1,000 text pages, which means far fewer refills to pack for travel.

WHAT TO LOOK FOR

If you're looking for a truly portable printer, you'll have to prioritize weight, bulk, print quality, speed, per-page cost, and paper handling based on your individual requirements; use the reviews that follow to narrow your choices. If you need a low-volume, unobtrusive desktop printer, the choice is clear: Pick one of the ink jet printers, either the HP DeskJet 310 or the Canon BJ-10sx. Either way, don't let price be the deciding factor. Most of these printers have street prices between \$300 and \$400, which means that factors like consumables cost and convenience will quickly outweigh any difference in purchase price.

Our Contributors: BRUCE BROWN is a contributing editor to *PC Magazine*. MICHAEL J. ZULICH is a project leader at PC Magazine Labs, and LEON ERLANGER was the associate editor in charge of the story.



• HP DeskJet 310

This year's review finds once again that portable printing is a tradeoff between light weight and features. Hewlett-Packard's HP DeskJet 310 earns an Editors' Choice for its superior print quality, uncontested performance, and rock-bottom

operating costs. At 5.6 pounds travel weight, the DeskJet 310 is more than 2 pounds heavier than its lightest competitors, but the extra heft is worth it. The DeskJet 310 produces output that rivals lasers in clarity; it churns out text and graphics at more than twice the average speed of the other printers we tested. With an optional color ink cartridge, the DeskJet 310 is the perfect tool for making last-minute changes to presentations. It's also one of the few printers among those we tested that's really suited for everyday desktop use.

The suggested retail price for the DeskJet 310 is \$379, but street prices under \$300 are common. Consumables cost about 2 cents per page.

RUNNERS-UP

If you need a printer that's slimmer and lighter than the DeskJet 310, the

best choice is the \$399 Olivetti JP 50. (We discuss the Olivetti JP 50 in a sidebar because it was not shipping in the U.S. at the time of our review.) The Olivetti printer is a full pound lighter than the DeskJet 310, and its performance and output quality are nearly as impressive. For desktop use, the Canon BJ-10sx offers acceptable but not outstanding output at a lower per-page cost than the JP 50.

The Citizen Notebook Printer II garners an honorable mention for its combination of high-quality output, compact design, and long battery life. Priced at \$399, the Notebook Printer II can't match the performance or low per-page costs of the DeskJet 310, but it's worth considering as a lighter-weight alternative. Like the DeskJet 310, the Notebook Printer II can print in color.

Atlantic Technologies Inc.

• ATI SlimWriter

ALL REVIEWS BY BRUCE BROWN
Atlantic Technologies' \$499 ATI SlimWriter has the distinction of being the thinnest product we tested. The 48-element thermal fusion printer, which typically sells for under \$400, is truly portable and serves well as a convenience printer. Its drawbacks are an extremely high per-page operating cost, sluggish performance, and output that isn't good enough for presentations to customers.

The SlimWriter's travel weight is 3.4 pounds, which includes a combination AC adapter/battery charger and a nickel cadmium battery rated at 25 to 30 pages. An optional \$49.99 nickel hydride battery is rated at 35 to 50 pages.

To print, the SlimWriter folds in half lengthwise (4.3 by 12 by 2 inches). For

traveling, it unfolds to a 1-inch height and has a footprint just larger than a sheet of letter-sized paper.

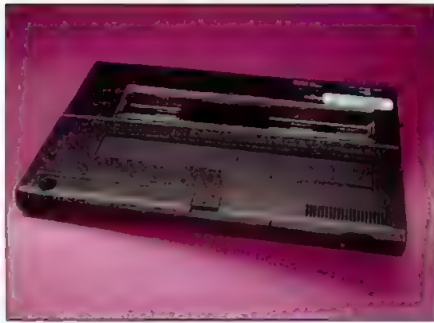
The SlimWriter is simple to set up and operate: Ribbons snap in easily; paper feeds from the back, one sheet at a time. To auto-feed multiple sheets you'll need the optional 20-page sheet feeder (\$129), a 1.85-pound accessory that adds 6.7 inches to the height and 7 inches to the depth.

The SlimWriter managed only 22 characters per second on our Text Speed test, the slowest result of any tested product. Only on the CorelDRAW test did it escape last place—by a mere 0.1 graphics pages per minute. Text quality is passable, but graphics printing looks like output from a fax machine. It offers Epson LQ-850, IBM Proprinter X24E, and Fujitsu DPL 24 emulations.

The SlimWriter's per-page cost is the highest in this lineup: 52 cents using the

Portable Printers

standard one-time ribbon cartridges, each good for 24,000 characters (about ten pages). To save money, buy multiuse ribbon cartridges—good for 250,000 to 300,000 characters—or replacement ribbons, available for either type of cartridge.



ATI SlimWriter

The multiuse cartridges reduce per-page costs to about 12 cents and minimize the number of spares you'll need to carry. In either case, the high per-page cost of the ATI SlimWriter makes it less than ideal as a printer to be used primarily on the desktop.

If portability is paramount, the SlimWriter is worth considering. But for other kinds of use, another product

may serve better.

► **ATI SlimWriter**
List price: \$499; 20-page sheet feeder, \$129; optional nickel cadmium battery, \$45; optional nickel hydride battery, \$49.99; single-use ribbon cartridge, \$5.20; multiple-use ribbon cartridge, \$11.50;

two ribbon refills for one-time cartridge, \$6.49; two ribbon refills for multiuse cartridge, \$14.95; Macintosh cable and software, \$79. Emulations: Epson LQ-850, IBM Proprinter X24E, Fujitsu DPL 24. Atlantic Technologies Inc., 6631 Amsterdam Way, Wilmington, NC 28405; 800-779-7705, 910-350-0700; fax 910-392-7093.

Circle 457 on reader service card

Canon Computer Systems Inc.

• Canon BJ-10sx

The Canon BJ-10sx, with a \$349 list price and an under-\$300 street price, is a faster version of the Canon BJ-10ex portable printer that we reviewed in August, 1992. The 360-dpi, 64-nozzle ink jet printer is moderately fast and produces acceptable, but not outstanding, output.

The Canon BJ-10sx's ream-of-paper dimensions and 5.3-pound travel weight mean that it's bulkier than many of the reviewed products, even before you include the 2.6-pound optional cut-sheet feeder that's a must if you want to print more than one page at a time. With the sheet feeder, the Canon takes up about a cubic foot of space. The sheet feeder works well once you set a printer DIP switch to indicate that it's installed, but the tip to set the switch appears only once

■ Olivetti JP 50: *Waiting in the Wings*

Olivetti Office USA's JP 50 portable printer won't be selling in the U.S. in quantity until September, but the production-level unit we tested in early summer looked like a winner. (We discuss it in this sidebar because of *PC Magazine's* policy of reviewing only shipping products.) At a list price of \$399 and with a probable street price of around \$350, the JP 50 offers reasonable speed and terrific print quality thanks to a 300-dpi, 50-nozzle ink jet printhead.

The Olivetti JP 50 follows the cigarette-carton school of design, measuring a relatively compact 2.5 by 11.7 by 5.1 inches when folded for travel. With the AC adapter its total weight is 4.6 pounds. No batteries were provided with the test unit, but it can use either common AA alkaline cells (it needs ten) or the rechargeable nickel cadmium or nickel hydride battery packs that the company sells for \$49.99 and \$99.99, respectively. The nickel cadmium battery is rated for 80 pages; the nickel hydride, for 160.

You don't have to decide whether to purchase or carry a separate sheet

feeder for the Olivetti JP 50 because it doesn't need one. The standard paper path, which starts at the top rear, is supported by foldout arms and can feed up to 15 sheets automatically. In testing the printer's paper feeding was flawless.

Changing the Olivetti JP 50's ink jet printhead cartridges is very quick and easy. A single \$23.99 printhead is rated for 210,000 characters, which works out to 84 pages at 29 cents per page. This per-page cost is significantly higher than that of the two other ink jet printers reviewed here, making the Olivetti printer less than ideal for desktop use.

Text and graphics print quality were both excellent, second only to the HP DeskJet 310. The Olivetti JP 50's 1.3 gppm graphics printing speed

and 57 cps text speed were both the second fastest, again trailing the HP in each case. In addition to seven internal fonts, software for 25 scal-

able Bitstream fonts is included. The printer is compatible with the HP DeskJet 500.

With a longer-than-usual three-year warranty, strong performance, and good print quality, the Olivetti could be one of the best



The Olivetti JP 50 offers fast speed as well as excellent text and graphics print quality.

bets for portable printing once it's available in the retail channel. □

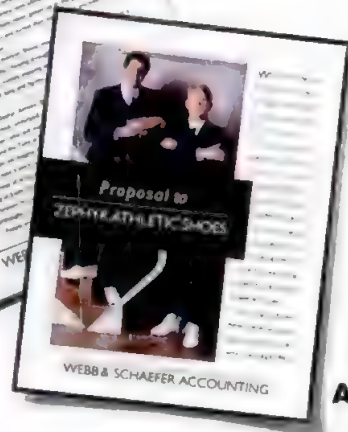
► **Olivetti JP 50** List price: \$399; printhead ink cartridge, \$23.99; nickel cadmium battery, \$49.99; nickel hydride battery, \$99.99; car adapter, \$44.99. Emulation: HP DeskJet 500. Olivetti Office USA, 765 U.S. Highway 202, Bridgewater, NJ 08807; 800-527-2960; 908-526-8200; fax 908-704-6571.

Circle 462 on reader service card



Proposal to
ZEPHYR ATHLETIC SHOES

Before



After

It makes everything you do look better than before.

Point, shoot, plug it into a Macintosh® (or a PC running Windows), and presto—you've discovered Apple digital photography. It's the fastest way to give everything from proposals to catalogs more impact. No film. No waiting. Just brilliant 24-bit color photos that will make even a modest memo stand out.

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He Grew Up With MTV.
He Gets 300 Cable Channels.
And, Unfortunately, He's In
Your Audience Today.



Introducing Z·NOTEFLEX,[™] The Ultimate Multimedia Presenter.

Audience attention spans are short. And if they snooze, you lose.

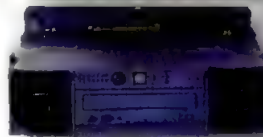
So what you need is a way to connect with them, a way to make your presentations really worth watching. The versatile, new Z·NOTEFLEX system, from Zenith Data Systems, is sure to keep them wide-eyed and endlessly entertained.

With the Z·NOTEFLEX system, you get all the capabilities of a multimedia workstation built around a powerful notebook computer. So, not only can you take the show on the road, you can carry it around in your hand.

Inside the Z·NOTEFLEX, a high-speed Intel 486 processor and a fast local bus deliver sharp, 256-color images and full-motion video that are sure to get attention. Particularly when the LCD display is detached and positioned in your viewers' direction.*

And, of course, no multimedia-ready system is complete without a CD-ROM drive.**

Video, however, is only part of the picture. Because with built-in,



Z·NOTEFLEX
up to
IntelDX4[™] 75MHz processor
16-bit business audio
active-matrix, 256-color
LCD display

FLEXSITE
LCD display stand

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battery charging bay
floppy drive bay

FLEXDOCK
enhanced port replicator
two type-III PCMCIA slots
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FLEXSHOW[†]
double-speed CD-ROM drive
amplified stereo speakers
two type-III PCMCIA slots
integrated power supply



16-bit audio, a microphone and stereo speakers, the Z·NOTEFLEX system is truly (pardon the expression) a sound investment.

Modularity is another attribute of the versatile Z·NOTEFLEX system. The notebook's processor, memory, drives and display are all user-upgradable. And optional FLEX modules and PCMCIA slots support a wide range of system enhancements, multimedia and peripheral solutions.

So to keep things simple, the Z·NOTEFLEX comes custom configured. You order the features you want today, then add others as the need arises.

When you think about it, no other notebook makes it so easy to connect—with co-workers, with customers, in the office, or out in the field. But that's the kind of thing people are learning to expect from ZDS.

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Benchmark Tests: Portable Printers

What the Numbers Mean

The results of the printer benchmark tests show a clear edge in speed for the ink jet printers, with the Hewlett-Packard DeskJet 310 the clear winner. The DeskJet 310 produced 67 characters per second on our Text Speed test, fully 10 cps more than its nearest competitor, the Olivetti JP 50. The Canon BJ-10sx, the remaining ink jet printer, produced a respectable 46 cps. Printing text at 34 cps, the Citizen Notebook Printer II (thermal fusion) was the fastest of the non-ink jet printers.

On our Graphics Speed test the DeskJet 310 again took top honors with 1.9 graphics pages per minute, followed by the Olivetti JP 50 at 1.3 gppm and the Canon BJ-10sx at 1.2 gppm. A large performance gap separated the ink jets from the rest: The Citizen Notebook Printer II turned in a score of 0.8 gppm; the ATI SlimWriter, 0.7 gppm.

The results of the Windows applications tests are as much a reflection of the Windows drivers as they are of the printers themselves. On the Word for Windows tests the HP DeskJet 310 yielded 89 cps—22 cps more than it did on the DOS test. The Olivetti JP 50, at 49 cps, and the Canon BJ-10sx, at 39 cps, followed the DeskJet 310.

On the CorelDRAW test, the DeskJet, at 1.0 gppm, was outpaced by the Olivetti at 1.4 gppm. The ATI SlimWriter, Citizen Notebook Printer II, and Seikosha LT-20XL, which had nearly identical scores, were the slowest performers.

—Analysis written by Michael J. Zulich

How We Tested

We used a Compaq Deskpro 486/33M with 8MB of RAM, a 310MB hard disk, DOS 6.2, and Microsoft Windows 3.1. Each printer ran a series of DOS-level tests for text and graphics speed, compatibility, and print quality.

For Windows 3.1 testing we used CorelDRAW 3.0, Word for Windows 2.0, and Lotus 1-2-3 for Windows. We installed Windows, accepting all of the defaults including a 2MB SmartDrive cache. We turned off virtual memory to eliminate the effects of disk spooling and bypassed the Windows Print Manager to avoid introducing additional overhead. We tested each printer using the Windows printer driver recommended by the vendor.

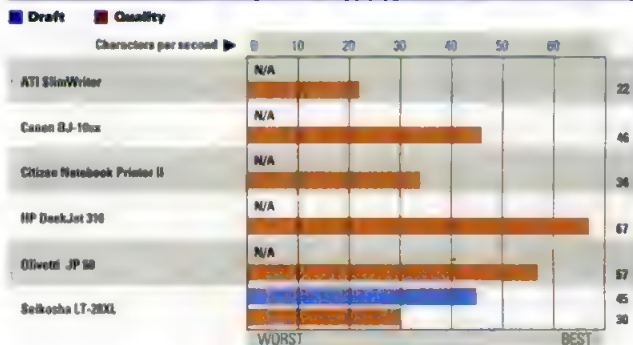
The **Text Speed** test measures the printer's speed in producing one copy of a two-page business letter with 1-inch margins in 10-cpi type. We ran the test once in quality mode and once in draft if the printer offered it.

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, and line art. The graphic is sent as a print file directly from DOS.

The **Word for Windows** test measures the printer's speed in producing a two-page report that uses multiple fonts and type styles.

The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art.

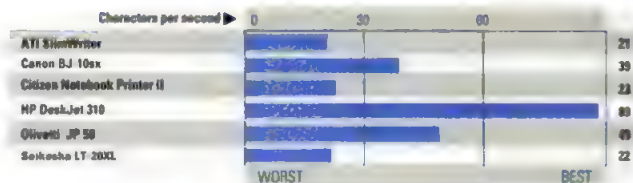
TEXT SPEED



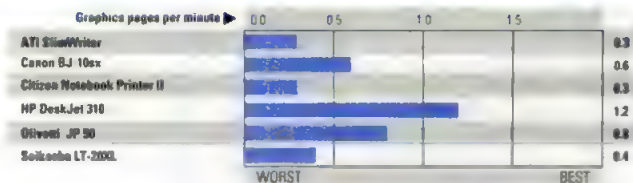
GRAPHICS SPEED



WORD FOR WINDOWS



LOTUS 1-2-3 FOR WINDOWS



CORELDRAW



N/A—Not applicable. This printer does not have a draft mode.

The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains pie, bar, and line charts.

Flexibility (ˌflek-səˈbil-ət-ē) *n.* 1. A feature previously not found in this category. *example:* For under \$800, **TI microWriter** printers give you the *flexibility* to start with **Adobe® PostScript®** or add it later; the comparable HP 4L does not.



THE UNDER \$800 PRINTER, REDEFINED.

If you're looking for a printer with a street price well under \$800*, you'll have a hard time finding one with as many features as a TI microWriter.

Let's compare it to our leading competitor, HP, starting with basic models. First, take flexibility. Ours lets you add PostScript now or later. With the HP 4L you can't add it at all. Take paper handling. Ours comes with a 250-sheet tray standard, theirs with just a 100-sheet. Speed? We give you 5 ppm, they give you 4. Yet in spite of all this, we still list for hundreds of dollars less.

Now, let's compare high end models. As you'll see from the chart, the features are basically comparable – till you get to price.

And once again, the TI microWriter is clearly the better value. In fact, we're so confident you'll like it, we'll give you our 30-day satisfaction guarantee.** For more information or a dealer near you, call **1-800-TI-TEXAS** (1-800-848-3927).

	TI microWriter Basic	HP 4L	TI microWriter PS23	HP 4ML
Print Speed	5 ppm	4 ppm	5 ppm	4 ppm
PostScript	Upgradeable	No	Standard	Standard
Paper Trays	(std.) 250 sheet	100 sheet	250 sheet	100 sheet
	(opt.) 250 sheet	Not Avail.	250 sheet	Not Avail.
List Price	\$599	\$849	\$799	\$1279

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Specifications in chart are based on information as of 1/94. *Estimated dealer price; dealer prices will vary. **Offer applies to returned in good condition microWriter and "Extending Your Reach With Innovation" are trademarks of Texas Instruments. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems, Inc. © 1994 TI

CIRCLE 304 ON READER SERVICE CARD

HARDWARE

Portable Printers

in the documentation in an easy-to-overlook spot.

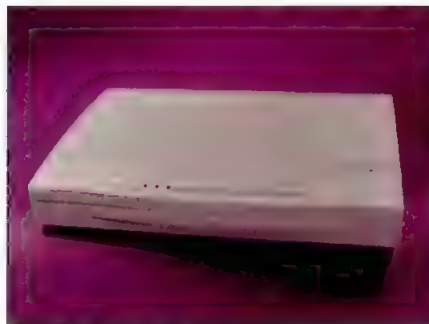
On our tests, the Canon BJ-10sx attained a midrange printing speed: 46 characters per second in quality mode for text and 1.2 graphics pages per minute for graphics. On the Windows applications tests, the Canon BJ-10sx scored slightly above average.

Output quality was good but not exceptional. By pressing two control-panel buttons simultaneously you can clean the print head, but even with a clean head text was more jagged and graphics less sharp than the HP DeskJet 310 and the Olivetti JP 50, the other two ink jet printers we tested. The Canon BJ-10sx supports Epson LQ-510 and IBM Proprinter X24E emulations and is compatible with the Canon BJ-10e portable printer.

Canon's nickel-cadmium battery is rated for 40 pages of operation. Ink cartridges have a 700,000-character rated life, enough for almost 450 pages of text. The BJ-10sx has a per-page cost of 5 cents.

The Canon BJ-10sx is a proven design with reasonable performance and output quality, but neither its capabilities nor its portability are exceptional.

► **Canon BJ-10sx** List price: \$349; 50-sheet



Canon BJ-10sx

feeder, \$90; battery pack, \$50; ink cartridge, \$25; carrying case, \$59; AC adapter, \$35. Emulations: Canon BJ-10e, Epson LQ-510, IBM Proprinter X24E. Canon Computer Systems Inc., 2995 Redhill Ave., Costa Mesa, CA 92626; 800-848-4123; 714-438-3000; fax, 714-438-3317.

Circle 458 on reader service card

Citizen America Corp.

■ **Citizen Notebook Printer II**

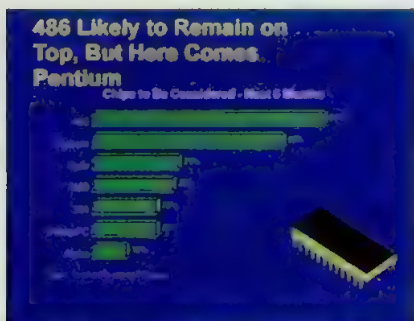
If you're looking for a truly portable printer with above-average output, Citizen America Corp.'s Citizen Notebook Printer II just about has it all: compact design, light weight, long battery life,

and color capability. It's a solid choice for printing black text with occasional light color, and its 3.4-pound travel weight is tied for the lowest in this lineup. As a desktop unit, its drawback is a short 50-page ribbon life (printing text) and a consequently high 9.9-cent cost per printout.

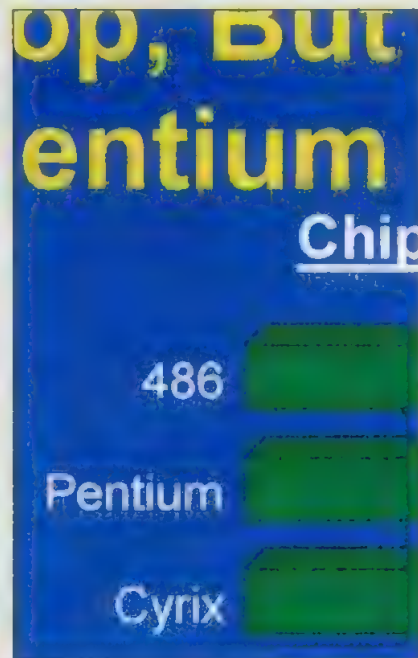
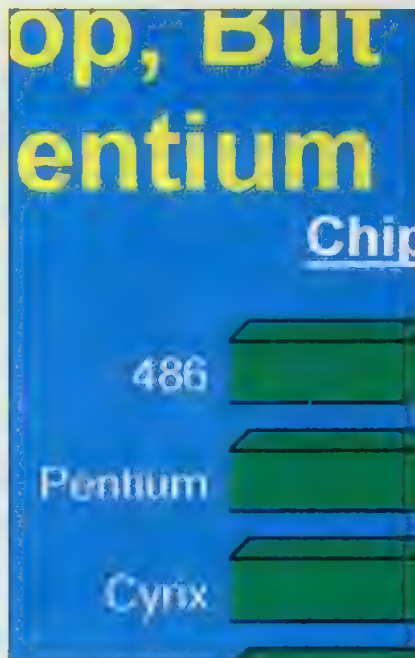
The Notebook Printer II is a 360-dpi thermal fusion unit with a \$399 list price and street price of about \$329. It measures only 2.1 by 11.7 by 4.1 inches, about the size of a folded newspaper, and can feed a small number of cut sheets automatically without requiring other attachments. Rated to handle up to 5 sheets, in practice the standard feeding mechanism handled as many as 11 sheets without jamming or double-feeding. A bottom feeder accepts heavy paper, including card stock.

The printer has a 60-element print head that uses a polymer resin ribbon and applies heat and pressure to form the characters and images. While its print quality is a step up from that of the ATI SlimWriter, the other thermal fusion printer we tested, its black text output is not as clear that of the ink jet printers reviewed here. Color output from this printer was crisper and brighter than that from the HP DeskJet

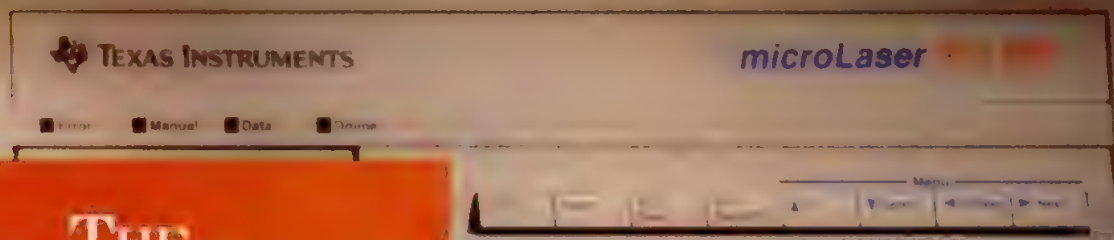
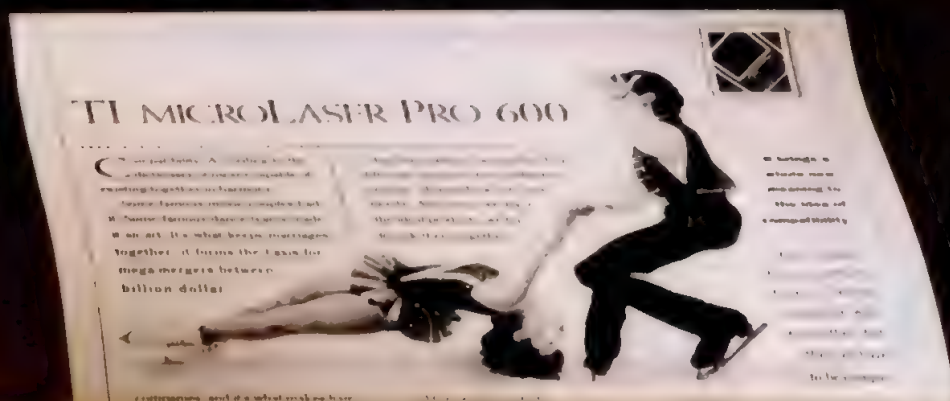
■ Color Printing on the Road



Shown here are a screen shot of a business graphic (left) as well as sections of actual-size color output from the Citizen Notebook Printer II (center) and the HP DeskJet 310 (right). The Notebook Printer II's graphics and text output is crisper and the colors brighter than the output from the DeskJet 310, but heavy banding is noticeable in the blue background. The output from the DeskJet 310 crumpled slightly.



Compatibility (kəm·pat·ə·'bil·ət·ē) *n.* 1. A feature rarely found in this category. *example:* The **TI microLaser™ Pro 600** gives you Mac®, DOS, Windows®, PostScript® and PCL5 compatibility standard.



**THE
UNDER \$1400
PRINTER,
REDEFINED.**

When we set out to design the ideal 600 dpi printer, we asked thousands of users what they wanted most. And the result is the TI microLaser Pro 600. As you see from the chart, not only do we give you more, we charge you less. And if blazing speed for heavy graphics printing is required, check out our 40MHz PowerStep™ upgrade. It's a great way to protect your investment as your processing needs become more complex. We're so confident you'll like the TI microLaser Pro 600, we'll give you our 30-day

satisfaction guarantee.* For more information or a dealer near you, call **1-800-TI-TEXAS** (1-800-848-3927).

	TI microLaser Pro 600	HP LaserJet® 4MP
True 600 dpi	Yes	Yes
Speed/Processor	8ppm/RISC	4ppm/RISC
Emulations	PCL5/Adobe® PostScript 2	PCL5E/Adobe PostScript 2
40MHz Processor Upgrade	Optional	Not Available
Compatibility	Mac/DOS	Mac/DOS
Toner Cart. Life	15K pages†	3K pages
Paper Trays	250/250 sheet	250 sheet
List Price	\$1599**	\$1729

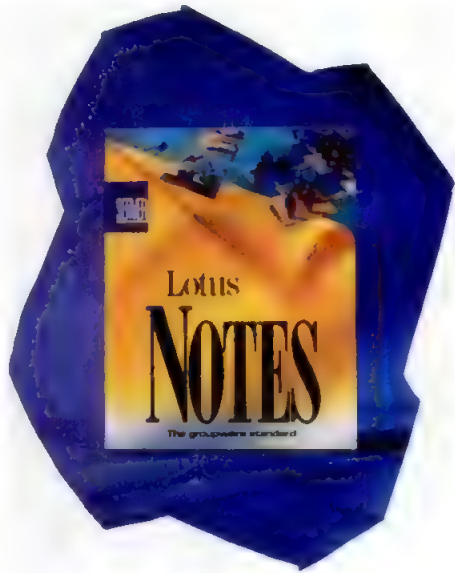
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Specifications in chart are based on information as of 5/94. *Offer applies. †Estimated output. **Estimated street price. Color \$1,499. Actual prices may vary. All coverage, maintenance, PowerStep and Extending Your Reach With Innovation are trademarks of Texas Instruments. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems, Inc. Windows is a trademark of Microsoft Corporation. Mac is a registered trademark of Apple Computer, Inc. LaserJet and HP are registered trademarks of Hewlett-Packard, Inc. © 1994 TI

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What To share. →



*You can make workgroup computing more complex
but you can't make it more complete.*

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You already know Lotus SmartSuite is a powerful collection of Windows™ applications, featuring 1-2-3,* Ami Pro* word processor, Freelance Graphics* presentation software, Lotus Approach* relational database and Organizer™ personal information manager. All top rated applications.

What you probably assumed, and rightly so, is that Lotus has equipped them with elegant links to Lotus Notes. If you have Notes, these FX, OLE and API links let you manage and collaborate on work, using information and functions from any of your desktop applications shared in workgroup "libraries" in Notes. So you can work together simultaneously, securely, and even remotely.

Lotus defined groupware, and the power of workgroups, with Notes. And Lotus continues these groupware innovations with SmartSuite.

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The fusion of Notes and SmartSuite actually extends the character and function of these familiar desktop tools.

1-2-3 ceases to be just a spreadsheet and becomes a model management system that lets team members search a library of different versions of worksheets and ranges while maintaining active financial reports equipped with alarms and thresholds that trigger work flow processes.

Ami Pro evolves from word processor to a highly flexible environment for creating and managing the flow of workgroup documents.

Freelance Graphics becomes a presentation management system where team members can work together, or browse through individual

slides of past presentations, to create their own custom presentations.

For anyone working with Notes data, Approach database becomes a shared reporting, forms and analysis tool. With Approach and Notes/FX™ sharing data, enterprise-wide, information-intensive workgroup applications are a sudden reality.

Add your own workgroup applications.

As an information manager, the combination of Notes and SmartSuite offers you a powerful set of tools with which to build and deploy a new class of workgroup applications.

These custom applications are fast and easy to build and can fit the specific needs of specific workgroups like a glove, to significantly speed up processes and improve individual and group productivity.

More productive people. A more productive organization.

Your organization doesn't have to be limited to individual productivity. Different people working across different applications can easily be a part of an integrated solution today, with SmartSuite and Notes.



This unique and highly developed combination of applications has consistently helped individual teams and entire enterprises show dramatic improvements in productivity.

Best of all, you don't have to wait. And you don't have to put together any puzzles. All you have to do is buy two boxes.

For a white paper entitled "The Lotus Notes-Enabled Desktop Strategy" just call 1-800-TRADE-UP, ext. 9865.** Or you can order your Lotus SmartSuite upgrade for just \$299.*



NOTES FROM THE FIELD

To improve productivity, the State of Oklahoma chose to equip many of its public agencies with SmartSuite and Notes. Used by officials for idea and strategy sharing, these applications are also used by thousands of employees around the state with desktop and laptop computers to share information on finance, health, and crime control, among other applications. The move has proven very popular, and more government departments are considering going on line with both SmartSuite and Notes.

How to Read the Printer Guide

• Text Speed

Our standard Text Speed test uses a two-page business letter. We report the output speed in characters per second (cps).

Graphics output

The photo shows how well the printer reproduces halftones.

Text output

This TrueType font sample shows how well the printer reproduces text. The inset shows the font sample enlarged to five times the original size.

Gray-scale output

This bar shows how well the printer reproduces various gray shades.

Line art

This shows how well the printer handles curves and both thick and fine lines.

ATI SlimWriter

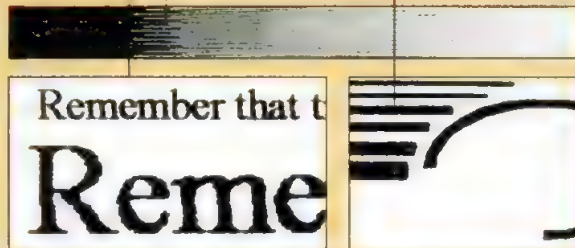
\$499

48-element thermal fusion printer

- Draft Text Speed: N/A
- Quality Text Speed: 22 cps
- Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:

- Word for Windows: 21 cps
- CorelDRAW: 0.6 gppm
- Lotus 1-2-3 for Windows: 0.3 gppm



• Graphics Speed

The scanned photo doubles as an output sample and a part of our Graphics Speed test. We report the output speed in graphics pages per minute (gppm).

• Word for Windows

The Word for Windows test uses a two-page business report that includes multiple fonts and type styles. We report the output speed in characters per second (cps).

• CorelDRAW

The CorelDRAW test uses the same file as the Graphics Speed test, printed from within Windows using CorelDRAW. We report the output speed in graphics pages per minute (gppm).

• Lotus 1-2-3 for Windows

The Lotus 1-2-3 for Windows test uses a two-page spreadsheet with embedded business graphics. We report the output speed in graphics pages per minute (gppm).

N/A—Not applicable: This printer does not have a draft mode.

Canon BJ-10sx

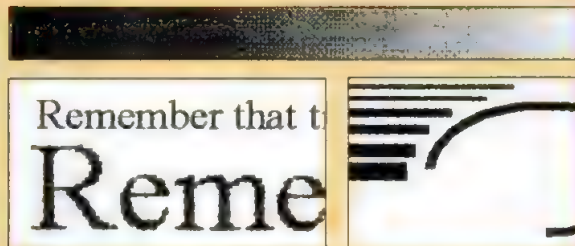
\$349

64-nozzle ink jet printer

- Draft Text Speed: N/A
- Quality Text Speed: 46 cps
- Graphics Speed: 1.2 gppm

WINDOWS APPLICATIONS:

- Word for Windows: 39 cps
- CorelDRAW: 1.0 gppm
- Lotus 1-2-3 for Windows: 0.6 gppm



Citizen Notebook Printer II

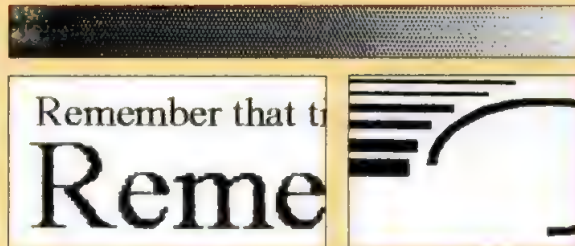
\$399

60-element thermal fusion printer

- Draft Text Speed: N/A
- Quality Text Speed: 34 cps
- Graphics Speed: 0.8 gppm

WINDOWS APPLICATIONS:

- Word for Windows: 23 cps
- CorelDRAW: 0.8 gppm
- Lotus 1-2-3 for Windows: 0.3 gppm



HP DeskJet 310

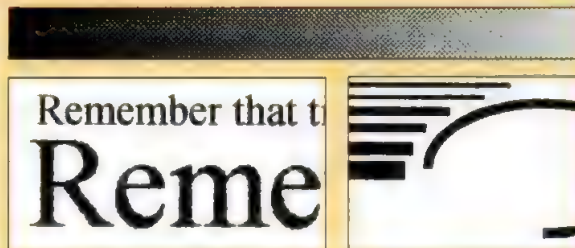
\$379

54-nozzle ink jet printer

- Draft Text Speed: N/A
- Quality Text Speed: 67 cps
- Graphics Speed: 1.9 gppm

WINDOWS APPLICATIONS:

- Word for Windows: 89 cps
- CorelDRAW: 1.0 gppm
- Lotus 1-2-3 for Windows: 1.2 gppm



HARDWARE

Portable Printers

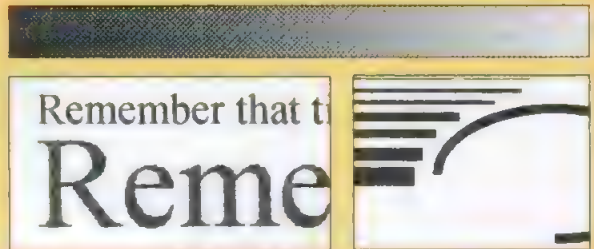
Olivetti JP 50

\$399

50-nozzle ink jet printer

Draft Text Speed: N/A
Quality Text Speed: 57 cps
Graphics Speed: 1.3 gppm

WINDOWS APPLICATIONS:
Word for Windows: 49 cps
CorelDRAW: 1.4 gppm
Lotus 1-2-3 for Windows: 0.8 gppm



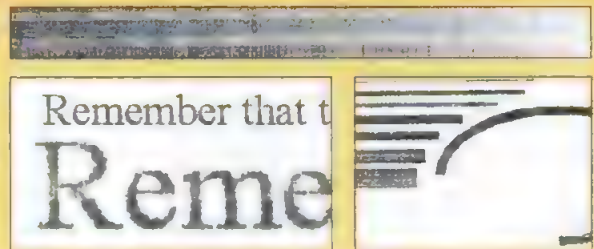
Seikosha LT-20XL

\$549

24-pin dot matrix printer

Draft Text Speed: 45 cps
Quality Text Speed: 30 cps
Graphics Speed: 0.5 gppm

WINDOWS APPLICATIONS:
Word for Windows: 22 cps
CorelDRAW: 0.5 gppm
Lotus 1-2-3 for Windows: 0.4 gppm



310 but showed more banding.

Citizen estimates that the Notebook Printer II can produce 30 graphics or 50 text pages on its battery. On our Text Speed test, it attained 34 characters per second—below average, but not by much. Its score of 0.8 graphics pages per minute on our Graphics Speed test was also competitive, but its Windows application scores were near the bottom of the pack.

The printer's control panel is the most complete of any we tested: It lets you select fonts and configurations as well as adjust paper thickness and contrast. The Notebook Printer II offers Epson LQ-860 and IBM Proprinter X24E emulations and is compatible with Citizen GSX printers. Since its parallel port is proprietary, Citizen includes a special 41-inch connector cable.

On the whole, the Citizen Notebook Printer II strikes a good balance

between portability and functionality.

► **Citizen Notebook Printer II** List price: \$399; 30-sheet feeder, \$69; battery pack, \$69; car adapter, \$49; carrying case, \$49; black ink cartridge, \$4.99; color ink cartridge, \$6.99. Emulations: Epson LQ-860, IBM Proprinter X24E. Citizen America Corp., 2450 Broadway, #600, P.O. Box 4003, Santa Monica, CA 90411-4003; 800-477-4683, 310-453-0614; fax 310-453-7532. Circle 459 on reader service card

Hewlett-Packard Co.

EDITORS' CHOICE HP DeskJet 310

At 5.6 pounds with battery and AC adapter, Hewlett-Packard's color-capable DeskJet 310 printer is a little heavier than most of its competitors, but it's also relatively fast and produces gorgeous output. HP sells the DeskJet 310 as a portable printer that can also do low-volume duty on the desktop, a dual role that the DeskJet 310 fills adeptly. The \$379 ink jet printer has a street price of around \$299, making it the lowest-priced of the printers in this review. You can even print in color (including a composite black) by replacing the black ink cartridge with a three-color version. The DeskJet 310 doesn't offer four-color printing, however, so it may not be ideal for reports combining black text and color graphics.

The DeskJet 310 folds shut for travel into a 2.5- by 12.1- by 5.7-inch brick. Unfolded and with the sheet feeder attached, the printer occupies a surface area of about a foot square. The sheet feeder is available either as a \$99 option or bundled with the printer for a total price of \$455. If you don't use the sheet feeder you have to feed paper one sheet at a time, a slow but smooth operation that caused no paper jams or twisting on our tests.

With a 67-character-per-second score on our Text Speed test and 1.9 graphics pages per minute score on our Graphics Speed test, the DeskJet 310 is by far the fastest printer tested. On Windows application tests its performance was equally striking.

Black text and graphics approach laser quality except when examined under close scrutiny, and three-color (cyan, magenta, yellow) output is bright and rich. The DeskJet 310 supports the



Citizen Notebook Printer II



HP DeskJet 310

► SUMMARY OF FEATURES

Portable Printers

Products listed in alphabetical order

■ = YES □ = NO

	ATI SlimWriter	Canon BJ-10sx	Citizen Notebook Printer II	HP DeskJet 310	Olivetti JP 50 *	Seikooha LT-20XL
List price	\$499.00	\$349.00	\$399.00	\$379.00	\$399.00	\$549.00
Battery option	\$45.00 (nickel cadmium), \$75.00 (nickel hydride)	\$50.00	\$69.00	\$49.00	\$49.99 (nickel cadmium), \$99.99 (nickel hydride)	\$78.00
Sheet feeder	\$149.00	\$80.00	\$89.00	\$99.00	Built-in foldout arms	Built-in paper tray
Physical Characteristics						
Dimensions without sheet feeder (HWD, in inches)	4.3 x 12 x 2	1.9 x 12.1 x 8.7	2.1 x 11.7 x 4.1	2.5 x 12.1 x 5.7	N/A	N/A
Dimensions with sheet feeder (HWD, in inches)	11 x 12 x 9	12 x 12 x 12.3	3.2 x 11.7 x 4.1	10.5 x 12.9 x 11	2.5 x 11.7 x 5.1	2 x 14.8 x 11.3
Weight with AC adapter and battery	3 lbs. 6 oz.	5 lbs. 5 oz.	3 lbs. 6 oz.	5 lbs. 10 oz.	4 lbs. 10 oz.	7 lbs. 13 oz.
Print technology	Thermal fusion	Ink jet	Thermal fusion	Ink jet	Ink jet	Dot matrix
Number of print elements	48	64	60	54	50	24
Maximum resolution (dpi)	360	360	360	300	300	180
Color capability	□	□	■	■	□	□
Installed memory	40K	37K	18K	48K	32K	1K
Parallel/serial interface	■ Optional	■ □	■ ■	■ □	■ □	■ □
Rated battery life (in text pages)	25-30 (nickel cadmium), 35-50 (nickel hydride)	40	50	100	80 (nickel cadmium), 160 (nickel hydride)	45
Works with AA batteries	□	□	□	□	■	■
Paper Handling						
Number of pages supported by feeder	20	50	30	60	15	50
Maximum rated paper weight (pounds)	22	28	60	24	22	21
Maximum rated paper width (inches)	8.5	8.5	8.5	8.5	8.5	8.5
Media supported:						
Cut sheets/Multipart forms	■ □	■ □	■ □	■ □	■ □	■ □
Continuous-form/roll paper	□ □	□ □	□ □	□ □	□ □	□ □
Overhead/card stock	■ □	■ ■	■ ■	■ ■	■ □	□ □
Envelopes/Labels	■ □	■ □	■ ■	□ ■	■ □	□ □
Features						
Supported emulations	Epson LQ, Fujitsu DPL-24, IBM Proprinter	Epson LQ, IBM Proprinter	Epson LQ, IBM Proprinter	HP DeskJet, HP PCL 3	HP DeskJet, HP PCL 3	IBM Proprinter
Control-panel buttons:						
Line/form feed	■ ■	■ ■	■ ■	■ ■	□ ■	■ ■
Emulation	□	□	■	■	□	□
Print mode/Typeface	□ □	■ □	□ □	■ ■	■ □	■ □
Number of built-in typefaces	4	3	5	4	4	1
Scalable built-in typefaces	None	None	None	14	None	None
Windows driver	■	■	■	■	■	□
Technical Support						
Toll-free technical support	□	■	□	■	■	■
Telephone support hours (eastern time)	8:00-6:00 M-F	8:00 A.M.-11:00 P.M. M-F, 11:00-6:00 Sat	11:00-7:30 M-F	10:00-9:00 M-F	8:30-6:00 M-F	9:00-5:00 M-F
BBS	□	■	■	□	□	■
Warranty	2 years	2 years	2 years	1 year	3 years	2 years

N/A—Not applicable. This printer has a built-in sheet-handling mechanism.

* The Olivetti JP 50 was not shipping in the U.S. at the time of our testing.

HP DeskJet and HP PCL 3 emulations.

The package includes a Windows printer driver disk with HP's SmartColor, which analyzes each print job and prompts you to insert the black or color ink cartridge as required. HP estimates that one black ink cartridge will last for 1,000 text pages; color ink, for 676 pages. Per-page cost for black text works out to a low 2.2 cents; color at 30 percent page

coverage is estimated at 23 cents. The DeskJet 310's battery is rated for 100 pages.

HP's warranty on the DeskJet 310 is the shortest of any printer in this review: just one year. In nearly every other way, however, the DeskJet 310's features lead the pack. If you can put up with its slightly higher bulk and weight, the DeskJet 310's speed and extremely high print

quality will pay you back richly.

► **HP DeskJet 310** List price: \$379; with sheet feeder, \$455; 60-sheet feeder, \$99; battery, \$49; battery charger, \$99; black ink cartridge, \$21.95; color ink cartridge, \$34.95. Emulations: HP DeskJet and HP PCL 3. Hewlett-Packard Co., P.O. Box 58059, Santa Clara, CA 95051; 800-752-0900; fax, 800-333-1917.

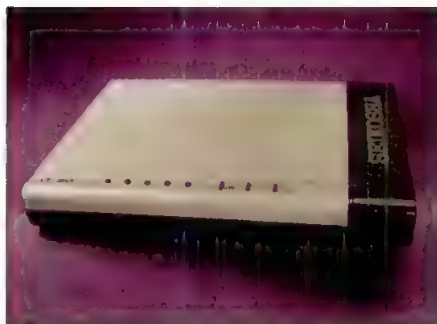
Circle 460 on reader service card

Seikosha America Inc.

Seikosha LT-20XL

Seikosha America's LT-20XL (\$549 list; street price, about \$349) 24-pin dot-matrix printer is the only unit we tested that you can put beneath your computer, and its integrated 50-sheet paper tray is a real convenience. The LT-20XL is also the only reviewed product that can handle multipart forms. But its appeal is diluted by a hefty 7.8-pound weight (including AC adapter and battery pack), marginal print quality, and poor performance.

The Seikosha LT-20XL's battery pack is a tray that slides into the body of the printer, replacing the removable AC power supply. You need to supply 13 off-the-shelf AA alkaline batteries or use an optional rechargeable battery set that Seikosha sells for \$77.99. Either way, Seikosha estimates that you can print about 45 pages. Ribbons are rated to last for a million characters, or about 400 pages; per-page cost is a competitive 3.7 cents, second in this roundup only to the



Seikosha LT-20XL

HP DeskJet 310 printer.

Print quality is particularly weak: Output resembles that of 9-pin printers, even with a new ribbon and careful print-head adjustment. Text printing was adequate for personal and draft work, but graphics were grainy and showed severe banding and streaking.

The Seikosha LT-20XL printer was the only tested model to offer a draft mode for faster printing, but even when its draft mode was compared against quality mode for other printers its performance was unexceptional. On our other tests of print

speed, the LT-20XL placed last or next to last. On the Text Speed test in quality mode, it produced 30 characters per second. On the Graphics Speed test, it managed only 0.5 graphics pages per minute. Windows application performance was similar: 22 cps in Microsoft Word; 0.5 and 0.4 gppm in CorelDRAW and Lotus 1-2-3 for Windows, respectively.

If you need to print multipart forms, the Seikosha LT-20XL can do the job; for other portable applications, it can't compare with the alternatives. □

► **Seikosha LT-20XL** List price: with battery holder and AC power pack, \$549; extra paper tray, \$46.99; carrying case, \$74.99; font expansion ROM, \$29.99; car adapter, \$99.99; nickel cadmium battery pack, \$77.99; AA battery pack, \$74.99; Sub-C battery kit (100 pages of printing per charge) with charger, \$121.99; battery charger, \$46.99; ribbon, \$14.99. Emulation: IBM Proprinter X24E. Seikosha America Inc., 10 Industrial Ave., Mahwah, NJ 07430; 800-338-2609; 201-327-7227; fax, 201-818-9135.

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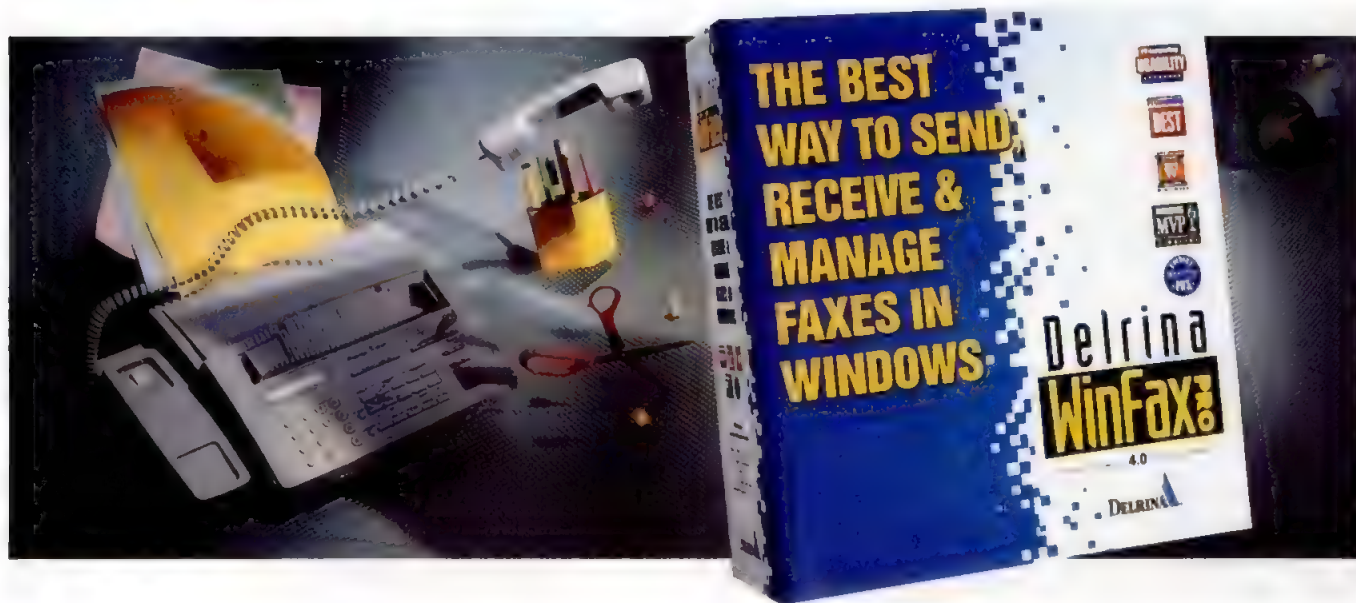
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Printer Sharing Network

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	Part Number	Suggested Retail
Starter Kit for 2 computers/1 printer	PSN1	\$ 199
Add-on Computer Module	PSN2	59
Add-on Printer Module	PSN3	69

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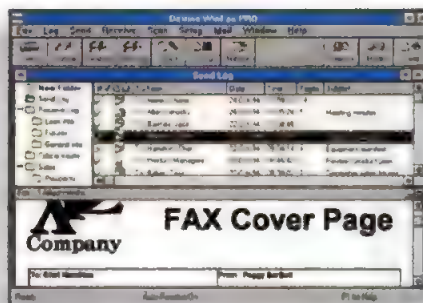
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CIRCLE 250 ON READER SERVICE CARD

REMOTE-CONTROL SOFTWARE

How to Be in 2 Places at Once

Today's remote-control packages break the tyranny of the workplace: Now you can do it here even if you keep it somewhere else.

By Ted Stevenson

Has it ever happened to you? The kids are finally in bed and you've settled down in front of your home-office PC to put the finishing touches on the presentation you'll be giving tomorrow morning; you reach into your briefcase and realize, to your horror, that you've brought home *the wrong floppy disk*? Or maybe it's a Saturday afternoon (after dealing with the shopping, the tune-up, and the pediatrician), and you still need to work on the quarterly sales figures for the report your boss expects to see on her desk first thing Monday morning. It's important; important enough that you seriously consider dashing into the office—getting to bed three hours later than planned, or canceling those reservations for the evening. If only there were a way . . .

An easy remedy for this nightmare is remote-control software, which lets you connect with a PC in another location (usually via modem and phone line), taking control of that system and all of its storage resources and network



► IN THIS REVIEW

<i>Carbon Copy</i>	282	<i>Remotely Possible/DIAL</i>	307
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connections. Remote-control software lets you work when you need to work, regardless of your physical whereabouts.

Of course, remote-control software isn't just for emergencies; it's for any situation in which you need to get at data, applications, organizational e-mail, or another person's PC (typically for technical support or training) when they're not where you happen to be. It is invaluable for serious telecommuting work styles, automated data collecting, help-desk activities, and many types of technical support where one look at a CONFIG.SYS file can be worth a thousand words. At least one PC manufacturer (Gateway 2000) is bundling remote-control software (CoSession) with its systems.

A RARE SPECIES

So why is remote-control software still a relatively rare bird? Until recently the barriers to its acceptance were high: It was difficult to set up, slow once it was running, and limited in its ability to handle graphics—notably Microsoft Windows. Since our last look at remote-control software, vendors have lowered most of these hurdles to the point where there's really no reason not to take the jump. They've also made improvements in other areas, such as security.

In this roundup, we examine all cur-



- **Norton pcAnywhere for DOS**
- **Norton pcAnywhere for Windows**

Choosing the best of the current crop of remote-control packages was a difficult challenge. While none of our eleven products “does it all,” almost all of them go well beyond the competent—which means

they are easy to install and configure (a major bugbear for remote-control products in the past) and that they handle the basic tasks (connecting; managing keyboard, display, and mouse activities on the host machine in both DOS and Windows sessions; and transferring files between two systems) with efficiency and aplomb. It's hard to go far wrong here, and that's an accolade for the vendors. This category has definite-

ly matured since we last explored it.

That said, some packages do stand out. Our Editors' Choices, Norton pcAnywhere for DOS, Version 5.0, and pcAnywhere for Windows, Version 1.0, while not the strongest products in every respect, are overall the most robust and multitalented of the bunch. Both offer clean, easy-to-navigate interfaces, easy-to-use file-transfer modules, and reasonable security features. Both provide

recently available remote-control packages that operate asynchronously (over modem and phone line). The roundup includes Windows-based products, DOS-based packages, and one OS/2 product that supports OS/2 apps as well as DOS and Windows clients. Three of our eight vendors—Microcom (Carbon Copy), Symantec Corp. (Norton pcAnywhere), and Triton Technologies (CoSession)—offer separate DOS and Windows packages. Ocean Isle Software's ReachOut Remote

Control provides DOS and Windows modules in the same box.

WHAT'S IN A NAME?

The question of who's doing what to whom—and how you refer to each of those parties—can be confusing when dealing with remote-control software. To begin with, remote-control packages consist of not one but two symbiotic parts. The PC that is called or “visited” (and thereafter controlled) by an outside sys-

HIGHLIGHTS

Remote-Control Software

VERSATILITY is the name of the game with the current generation of remote-control software packages. The eleven DOS-, Windows-, and OS/2-based packages in this roundup give you the ability to run another PC, transfer files with a remote PC, and log on to on-line services—and many have LAN versions that allow remote access across the network. For even more versatility, many of the reviewed packages include BBS support and scripting features.

PERFORMANCE under Windows is better than ever, with speed increases

traceable to software technology—screen-caching techniques and transmission of GDI calls—that let packages avoid sending entire graphics screens again and again. The availability of faster modems has also helped speed up transmissions.

EASY INSTALLATION is the rule today. In most cases, modem setup involves two or three simple choices—and security isn't much tougher. All of the tested packages are good system citizens, apprising you of any and all changes their installation programs make to system and .INI files.

CALLBACK SUPPORT provides both security and flexibility: After the remote user logs on to the host and sends the password, the host returns the call, which minimizes the risk of unauthorized access to the host—and generally means that the company pays the phone bill! In the case of *prompted* or *roving* callback, the caller actually enters the callback number during the initial remote-to-host connection. This means that users can enjoy the convenience of remote control, security, and billing to the company while on the road—anytime, anywhere.

for a variety of preestablished hardware connections (to modems, direct serial links, and networks) that can be incorporated into any connection profile. Both provide a rich set of terminal emulations and file-transfer protocols for connecting to BBSs, on-line services, even mainframes. And both have impressively powerful and versatile scripting capabilities that can help with anything from logging onto CompuServe, to full, unattended on-line sessions that transfer files and execute DOS commands.

While the two siblings are very close in stature and temperament, they do have individual strengths. The DOS version, for example, is a much faster performer, both in file transfers and in video response time. Surprisingly, it blows the Windows version away even on Win-

dows display efficiency.

pcAnywhere for Windows, while just an average performer, gives you a neat Windows File Manager-like graphical file-transfer/file-management module. It also eases script creation, offering on-line tools that flatten the learning curve significantly. Both packages, in summary, are versatile, mature products with few rough edges.

Close behind are two packages to which we give honorable mention: Close-Up, Version 6.0, and ReachOut Remote Control, Version 4.02. Close-Up attempts far less than pcAnywhere, but succeeds admirably in everything it does. It is exceptionally easy to set up and interferes with your Windows drivers less than almost any other remote package. Included in the setup routine

is an extensive diagnostic evaluation of your hardware and software. Close-Up was among our fastest video performers, but scored in the middle of the pack on our file-transfer tests. ReachOut, a nice two-for-one deal (DOS and Windows versions come in the same box), reaches out for all the brass rings, catching some, missing others. It is a fast performer, and provides a wide range of Windows video resolutions and network connectivity. Still, it proves just a bit too wet behind the ears to hold the field with Symantec's more seasoned products. ReachOut had several bugs—although the vendor was responsive to our bug reports—and on-line help was lacking. In another generation, ReachOut will be a challenger of the first rank.

tem is generally called the *host*.

The controlling PC, which is typically but not always the caller, goes by a variety of names depending on the vendor: "guest," "viewer," and, most unusual, "teacher." For consistency, we use the term *remote*. Remote software modules are usually sizable standard applications.

In some products, such as Close-Up and CoSession, host and remote come as separate executables. By contrast, products such as Carbon Copy and pcAnywhere install the two modules under a single interface. Several products, including Carbon Copy, pcAnywhere, and PolyPM/2, come with built-in LAN functionality.

Just a few years ago, remote-control software required users to enter modem setup information, edit their system startup files, load drivers, and generally function like a technician. Today, installation is in most cases nearly effortless. While some products, such as Close-Up, may automatically identify the active comm port or the presence of a high-speed UART (comm port controller), even the packages that require you to supply this information can be up and running in a matter of two or three minutes.

Most remote-control products modify your system startup files, but these changes are minor. Some remote-control packages also alter your Windows SYS-

TEM.INI file, where they typically replace one or more drivers: display, mouse, or keyboard. There are pros and cons to the various approaches to doing this, but these packages do the job well, handling details in the background but fully documenting what they're doing and where originals of the files are stored.

REMOTE ENCOUNTERS

To enable a typical remote session, the host is set in call-waiting mode (which won't necessarily interfere with work on that PC, since hosts are generally fairly compact TSRs and can often be loaded into high memory). First, the remote connects with the host via modem. Then, log-on and password procedures, if any, are invoked. Now the remote user can control the host.

Once control is established, the remote user can run all the applications normally available to the host system, and can transfer files back and forth between the host and remote. If the host is connected to a network, the remote user can also access all network resources. But most host modules require you to load your net-

work drivers before loading the host software. If your drivers aren't up and running when you connect, you can't access the network for that session.

You may want to run an application on one system while working with files located on the other. To handle this situation, most vendors supply *drive mapping*, or *redirection*, utilities that let either system read from and write to drives on the other system directly. If, for example, you're running an app on the host that's editing a file located on your local system, you would map your C: drive as D: on the host system and work normally. Such *remote access* (as distinct from *remote control*) often involves running extra software, which acts essentially as a gateway utility, on both ends of the connection, and may involve yet another package to accomplish the initial setup.

BRAVE NEW WORLD

Windows support, which barely existed when we did our last remote story in 1992, is now almost universal. With the exception of Carbon Copy for DOS and Takeover, all packages—DOS-, OS/2-,

Our Contributors: KATHLEEN CASTER and JOHN CLYMAN are staff editors of *PC Magazine*. ANGELA HICKMAN is an editorial researcher at *PC Magazine*. BEN Z. GOTTESMAN is technical director for software at PC Magazine Labs. LAURA COX is a technical analyst at PC Magazine Labs. TED STEVENSON was the associate editor in charge of this story, and AMARENDRA SINGH was the project leader.

Suitability to Task:**Remote-Control Software**

To be effective, a remote-control package must be fast, reliable, and compatible with your needs. A package should be able to connect to the host machine, maintain the connection reliably, and run all the software on the host machine with ease and at a decent speed. We used these factors as guidelines as we evaluated the packages in this roundup.

Communications packages in general and remote-control packages in particular use a lot of terminology that can be confusing to the average user. With this in mind, we rate the ease and clarity of **setup and configuration**. During installation, packages should identify the port the modem is on and set it up automatically. In cases where the user's modem is not listed, a package should provide a number of generic modem definitions and an easy way to set up a user-specified modem. If changes are made to system files during installation, a package should let the user view and modify them before implementation. Also, during the installation process we looked for clear explana-

Loss of Termination

between the host and remote systems and of what was involved in installing both modules.

We also evaluate a product's ability to handle **remote control**. A remote

module should smoothly connect to the host machine, even at high speeds, and run the programs resident on the host while providing the user with status information. Also, a package should have a range of connect options—letting users launch DOS and Windows modes from the host and remote machines—and the ability to switch easily between DOS and Windows. We look for packages with an easy-to-use chat mode, good graphics-transmission speeds, and the ability to redirect printing between host and remote in both DOS and Windows. Also, a package should be able to deal with a host running in a higher resolution than the remote system.

The **remote access** score reflects a package's ability to let users access files residing on the host

SUITABILITY TO TASK		
	Power	Ease
Setup and configuration	POOR	EXCELLENT
Remote control	FAIR	GOOD
Remote access	GOOD	FAIR
Security	EXCELLENT	POOR

machine or the network

to which the host is attached. We look for full-featured file managers, drive mapping, file or directory synchronization, background file transfer, and the ability to let the user log on and off

the network while working remotely. We also look for **roving callback**, which means remote callback with the ability to change the callback number at log-on time.

We examine whether a package's **security** features are appropriate for single- or multiple-user access. A package should have a default password or should require users to define a remote user before he or she can log on. We look for varied security levels, such as the ability to let individual users control some of their log-on rights while limiting their access to system parameters such as directories and files. Also, a package should let users set the input and screen control of the host when being accessed by a remote machine and log remote access and activity.

or Windows-based alike—support running Windows and Windows applications on the host. With DOS-based remotes, you are typically limited to Super VGA (800-by-600 resolution with 16 colors), but Windows-based remotes tend to support 1,024-by-768 and beyond with 256 colors. Remotely Possible/DIAL, Version 4.0 supports true 24-bit (16.7 million) color depth. In many of the programs where the host is running a higher screen resolution, the remote provides scroll bars so you can move to all parts of the host screen.

While there is potentially a great demand on system resources as graphical screen information passes back and forth during OS/2 or Windows sessions, vendors have developed clever techniques for minimizing actual throughput: Caching screens or selected screen elements and sending only GDI calls rather than actual bitmaps are two popular ways of speeding operation in graphical environments, Windows or otherwise. The wide availability of inexpensive fast modems (14.4-Kbps and higher) has also had a significant impact on the success of graphical remote control as well.

TRANSFER, PLEASE

Typical business end users (as opposed to support personnel) are perhaps more likely to use a remote package's file-transfer functions than its actual control capabilities. And transferring files is an area in which most of our packages shine. Most provide a display of directory trees at both ends of the connection and let you tag and send files in either direction. Most offer several file-management commands, such as Delete, Rename, Local Copy, and Make Directory.

Most of the packages also offer at least a rudimentary form of directory synchronization or updating, in which the package identifies and writes new and updated files from the directory on one end of the connection to the corresponding directory on the other—in one operation.

Since most packages provide compression schemes and proprietary file-transfer protocols, both of which are tuned for speed, you'll probably be pleasantly surprised at how quickly you can get files back and forth. For special situations, some products offer alternatives to their proprietary transfer protocols, typically ASCII and Xmodem.

SECURITY COMPLEX

The larger the organization and the more people involved in a remote setup, the longer a shadow the question of security casts. In fact, lack of bullet-proof security has long been a barrier to MIS acceptance of remote control products. Today, every system offers at least the option of password-protecting remote connections. Callers may be asked for a log-on name and a password, or simply a connection password. Changes to host or remote password tables (or phone books, where log-on and password information is often stored) may be controlled by "master" passwords.

Callback is a security or convenience feature, depending on your point of view, in which, upon completion of a successful log-on, the host calls the remote system back to make the final connection. A standard callback (where the call is to a predetermined number) at once ensures that no one but the designated individual can access the host system, even with the password, and makes sure that the host (usually the office) pays for the call.

The prompted or "roving" callback option, offered by several products, offers flexibility to traveling users. The host

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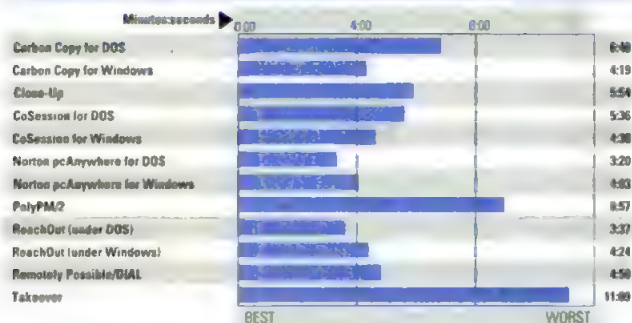
Performance Tests: Remote-Control Software

Norton pcAnywhere transferred files with great speed and, like Close-Up and ReachOut, handled graphics with efficiency and ease.

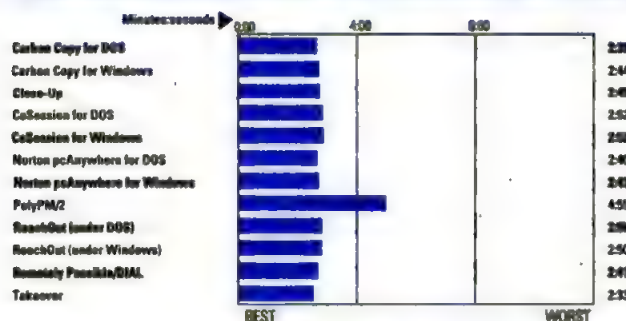
What the Numbers Mean

On our first **Remote File Transfer** test, the range of transfer times was quite substantial, from Norton pcAnywhere for DOS, Version 7.0, which was able to transfer the test file in 3 minutes 20 seconds, to Takeover, Version 2.1, which took more than three times as long at 11 minutes 9 seconds. The

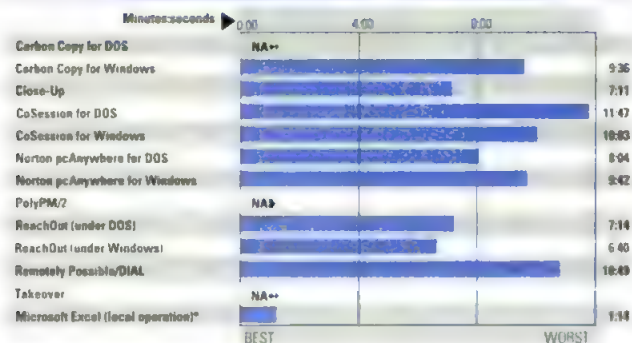
REMOTE FILE TRANSFER: UNCOMPRESSED FILE



REMOTE FILE TRANSFER: COMPRESSED FILE



MICROSOFT EXCEL 4.0 MACRO



NA** Not applicable This product does not support Windows on the host.
 NA* Not applicable This product does not run Windows in native mode.
 * Reported for comparison.

differences among transfer times of the packages diminish significantly on our second test, which involved transferring the same file, this time precompressed. On this test, Takeover went from slowest to fastest, and the narrow range of scores shows that once the data is compressed, all packages can send the data at pretty much the same speed. The notable exception to this is PolyPM/2, Version 2.20, which was unable to use a higher-speed modem to its full potential.

Our **Microsoft Excel 4.0 Macro** test measures a product's ability to handle remote control of a graphical application. The various programs use different schemes to speed up the transfer of graphics information across a phone line just as they do to transfer files. DOS programs typically send an initial full-screen image, then update with changes only. Windows packages follow up on the initial full screen with either screen changes or Windows' screen-writing instructions (GDI calls). The latter method allows the remote-control package to shoulder some of the graphics-processing burden. The most recent advance in graphics speed is *screen caching*, where the remote system caches screens or portions of screens so that when the same image is redisplayed, it can simply be called from the remote system's memory rather than being retransmitted. ReachOut Remote Control, Version 4.0, goes so far as to store screen information on-disk ready for future on-line sessions.

The three packages that scored the best times on this test—ReachOut, Close-Up for DOS and Windows, Version 6.0; and pcAnywhere for DOS—all use some form of screen caching, showing the obvious benefits of this technique. Although OS/2 can run Windows sessions, we did not include a score for PolyPM/2, because this would have been an unfair comparison.

How We Tested

We tested all remote packages on a Compaq Deskpro 486/33M with 8MB of RAM (12MB for OS/2) and a 340MB hard disk. Each test machine was configured with DOS 6.2 and Microsoft Windows 3.1 (using a 20MB permanent swap file with 32-bit disk access enabled), running in standard VGA mode. (OS/2 2.11 was used for PolyPM/2). SmartDrive 5.0 was set with write-behind cache enabled for faster performance. We used the Practical Peripherals 1400FXSA V.32bis modem and remote package settings for compression and error correction.

For our first **Remote File Transfer** test, we use a highly compressible text file. This allows a package to demonstrate its ability to compress on the fly either by using its own compression or by allowing the modem to compress. Our second remote file-transfer test uses the same text file, but we precompress it using PKZIP v.2.04g. For this test, we evaluate a program's ability to recognize a compressed file and test its raw transmission speed over the phone line.

For our **Microsoft Excel 4.0 Macro** test, we run a series of operations, including cut-and-paste, recalculation, displaying a variety of charts, and resizing individual spreadsheets. During the replaying of the macro, we display some data multiple times, which allows packages that cache the screen on the remote to demonstrate the efficiency of their caching algorithms.

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prompts you for the callback number during the initial log-on process, allowing you to connect securely from virtually any phone—and on the boss's nickel.

ANCILLARY FUNCTIONS

Most remote packages can now handle chores other than their primary ones. These include logging onto BBSs and other dial-up on-line services and connecting to mainframes and/or networks.

Like a standard data-communications package, most remote-control products offer terminal-emulation modes that support modem and null-modem connections and standard file-transfer protocols such as Kermit, Xmodem, Ymodem, and Zmodem. These let you log on to CompuServe, MCI Mail, ZiffNet, vendor-support BBSs, and similar telecommunications facilities. While your choice of terminal emulations and transfer protocols is likely to be more limited with a remote-control package than with a full communications program, the best remote-control products give you all the choices you could realistically want.

Another feature we normally associate with comm products is scripted automation, but this too can be found in many remote-control products. At the lightweight end of the scale, products such as CoSession for DOS, Version 7.0, offer limited preconnection scripting—basically log-on assistance. At the heavyweight end, products such as Norton pcAnywhere allow full unattended log-on and session automation, including uploading and downloading of files and execution of all DOS commands.

LAN-HOPPING

Connecting to other workstations across the LAN is a special topic, and in our sidebar "Remote Control via LAN" we discuss some of the relevant products and issues. Some of the asynchronous remote-control products we review here can handle this chore right out of the box.

Given the ever-increasing versatility of remote-control packages and the potential for enormous productivity increases they offer, we wonder why everyone who regularly works in two or more locations hasn't made the modest investment in one. If we've piqued your interest, read on; in the reviews that follow, you're likely to find a product that makes a perfect match with your needs.

Microcom Inc.

• Carbon Copy for DOS Carbon Copy for Windows

BY AMARENDRA SINGH

With the release of the \$199 Carbon Copy for Windows, Version 2.0, Microcom has made gradual rather than dramatic enhancements. Improvements over the previous versions include support for a larger number of video resolutions, roving callback, and IPX-based LAN remote control. The package is also fully integrated with the \$199 Carbon Copy for DOS, Version 6.1, which combines Carbon Copy Plus (the DOS remote-control package) and Carbon Copy LAN.

Carbon Copy for Windows requires 2.7MB of hard disk space—including

programs. This means you can easily switch between LAN and asynchronous modes down the road.

IN THE BEGINNING

If you changed the video drivers during installation of the Windows package, Windows will restart, and the program will create a group with remote and host icons. When you launch either the host or the remote module, a small menu screen pops up with a series of clearly labeled icons that represent the various program options, such as Call a Host/Remote, and Wait for Call.

The Windows package's default installation sets up no password, making the system accessible to any caller. To establish security, you need to create users in the password table and turn on the re-

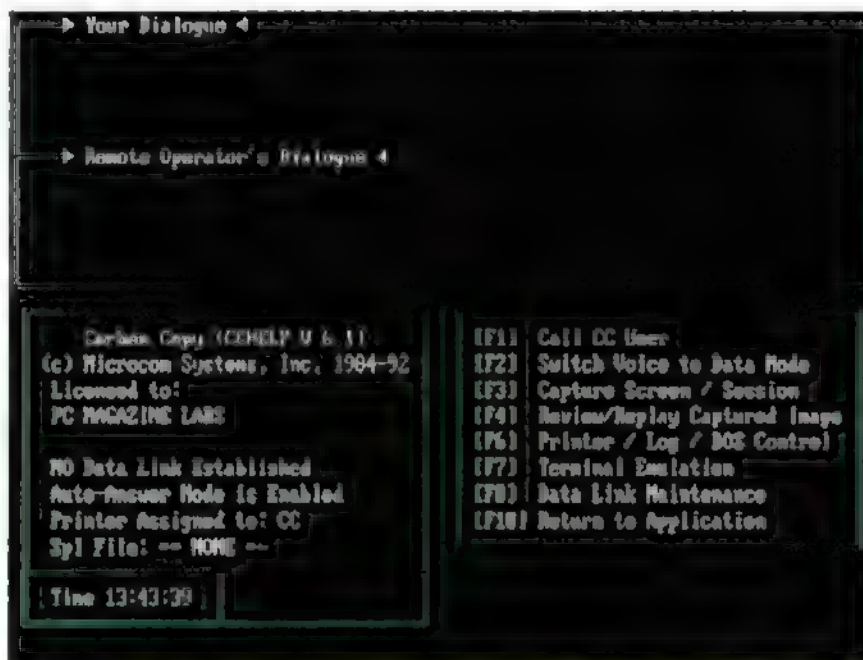
quired log-on feature. You can use the same menu to turn on callback support for individual users. On the whole, security is limited to access-level control. Once you are logged on to the machine, you have complete control of everything on it, except for the creation of phone book entries and access to the password table, which can be protected by a master password at the host end. This security is probably adequate for single-but not multiple-user access.

The DOS package's installation does create a simple default

password, which eliminates accidental or casual unauthorized log-on attempts. As with the Windows product, though, once you're logged on, you can do pretty much anything.

A NEW THING OR TWO

One of the new features introduced in Carbon Copy for Windows is roving callback support. With this feature, the callback number does not have to be predefined. The user can make the host dial back the remote machine by specifying on a case-by-case basis the number that will be called back. This feature is particularly useful for people who are on the road a lot and would like to be able to avoid paying for long distance charges. The feature also provides the security of logging the number that was called back.

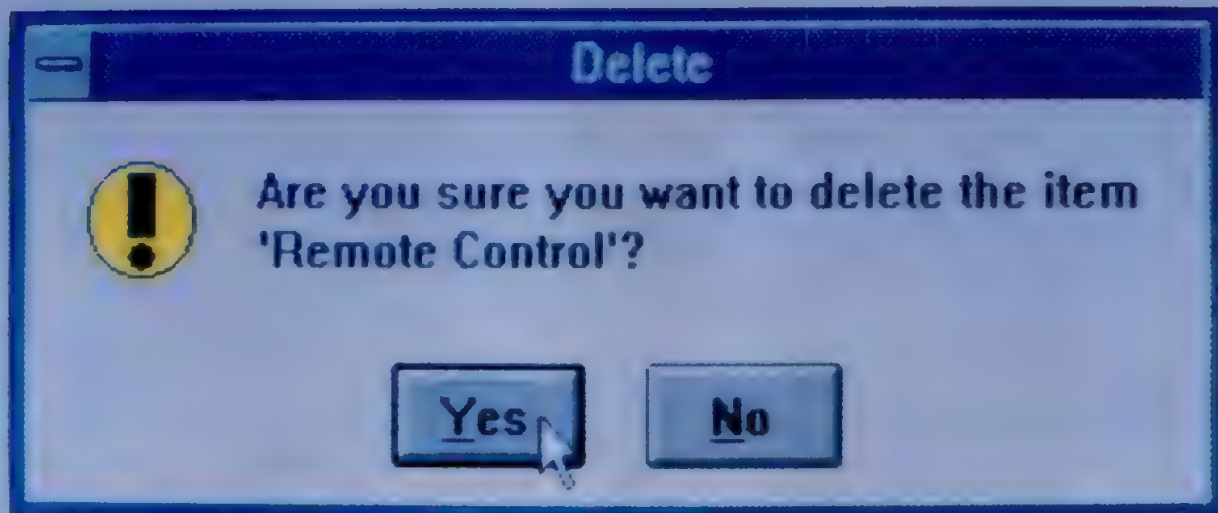


Carbon Copy for DOS's default main menu includes the chat dialog boxes.

host, remote, additional Windows help, and a DDE sample program (accessed over the company's BBS) that shows you how to execute script-like functionality. Although Carbon Copy replaces your video driver, the package is well behaved: The program first shows you all of the changes it will make, giving you the option of making these changes to an alternate file if you are not sure about them.

The DOS version installs from a single disk and occupies less than 500K with both host and remote modules installed. Carbon Copy for DOS and SoftKlone's Takeover are the only two packages in this roundup that do not handle Windows.

Both Carbon Copy for Windows and Carbon Copy for DOS actually include the LAN version in the main installation



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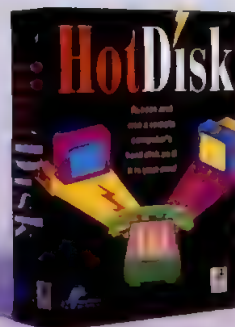
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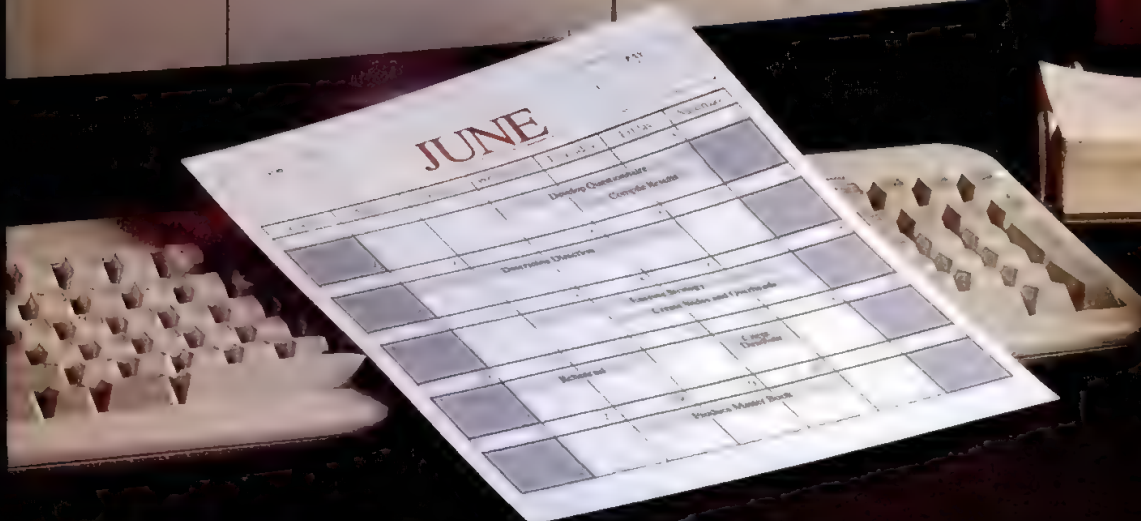
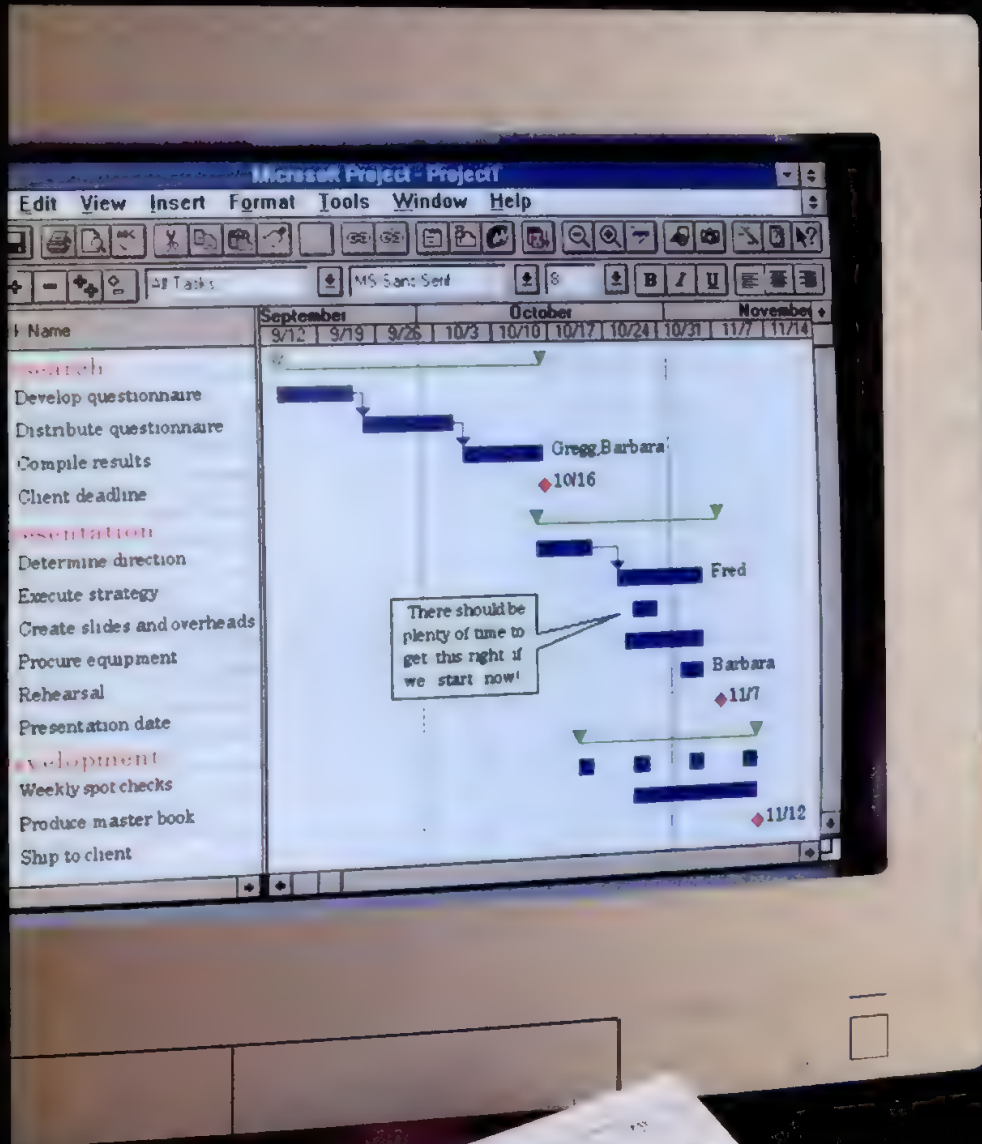
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Remote-Control Software

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**Carbon Copy for DOS,
Version 6.1****Carbon Copy for Windows,
Version 2.0**

List price: \$199. **DOS version requires:** On the host: 179K RAM, 388K hard disk space; DOS 3.1 or later; on the remote: 64K RAM, 244K hard disk space; DOS 3.1 or later.

Windows version requires: 2.7MB hard disk space, Microsoft Windows 3.1 or later. **In short:** The new version of Carbon Copy for Windows, while not a major upgrade, adds good functionality and maintains its easy-to-use interface. Among the improvements over the previous versions are support for a larger number of video resolutions, roving callback, and IPX-based LAN remote control. The DOS version, though not as feature-rich as its sister package, also includes LAN support.

Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062-5028, 800-822-8224, 617-551-1000; fax, 617-551-1021

SUITABILITY TO TASK (DOS)

	Power	Ease
Setup and configuration	FAIR	FAIR
Remote control	FAIR	POOR
Remote access	FAIR	POOR
Security	FAIR	FAIR

SUITABILITY TO TASK (WINDOWS)

	Power	Ease
Setup and configuration	GOOD	GOOD
Remote control	GOOD	EXCELLENT
Remote access	GOOD	GOOD
Security	FAIR	GOOD

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resolution host screens by creating a window on the remote machine. You can scroll around the image to view all of the different screen areas.

Some of Carbon Copy for Windows' facilities—remote control, chat, and file transfer, for example—will not run when other parts of the program are running. For example, in order to run the chat facility you need to shut down remote control. Fortunately, the simplicity of the menu system in Carbon Copy for Windows makes this relatively quick and easy.

STEADY PERFORMER

On our performance tests, neither version of Carbon Copy was among the top performers, but both did reasonably well in the file-transfer portion of the tests. The Windows version performed adequately with our Microsoft Excel 4.0 Macro test.

While most of the improvements in Carbon Copy for Windows are not earth-shattering, they are sufficient to make it a worthy contender among Windows-based remote-control packages. The most significant drawback is the lack of multilevel security, which makes the package more appropriate as a single-user than a multi-user solution. Carbon Copy for Windows' tremendous ease of use offsets its limitations. Version 2.5, due out by the time you read this, will include support for terminal emulation and drive mapping.

Carbon Copy for DOS, meanwhile, seems to be a revision designed only to keep the product alive on the DOS platform until users make the migration to Windows. On the other hand, the inclusion of LAN-based connectivity enhances its appeal for some users.

The file-transfer mode in Carbon Copy for Windows is easy to use, and will be familiar to Windows File Manager users. You can create directories from within the module and you can copy files not only through the menus but also through the same drag-and-drop techniques you would use in the Windows File Manager. The file-transfer mode in the DOS product leaves much to be desired: Transfers are carried out from a command line where you have to specify all of the file details. The module will, however, accept wildcards.

Carbon Copy for Windows deals with the problem of high-



At any time in Carbon Copy for Windows, you can choose to work across a LAN or via a modem.

Norton-Lambert Corp.

● **Close-Up**

BY AMARENDRA SINGH

The \$199 Version 6.0 of Norton-Lambert Corp.'s Close-Up is still a DOS-based program, but as with previous versions, it runs Microsoft Windows quite well. Like many of the programs in this roundup, Close-Up does not offer dramatic technological advances. Instead Norton-Lambert has beefed up areas in which the product was previously weak and has added a few substantial new features. The improvements include a new file-transfer module, the addition of roving callback capability, and the ability to free your communications port for other applications while Close-Up is still active in memory.

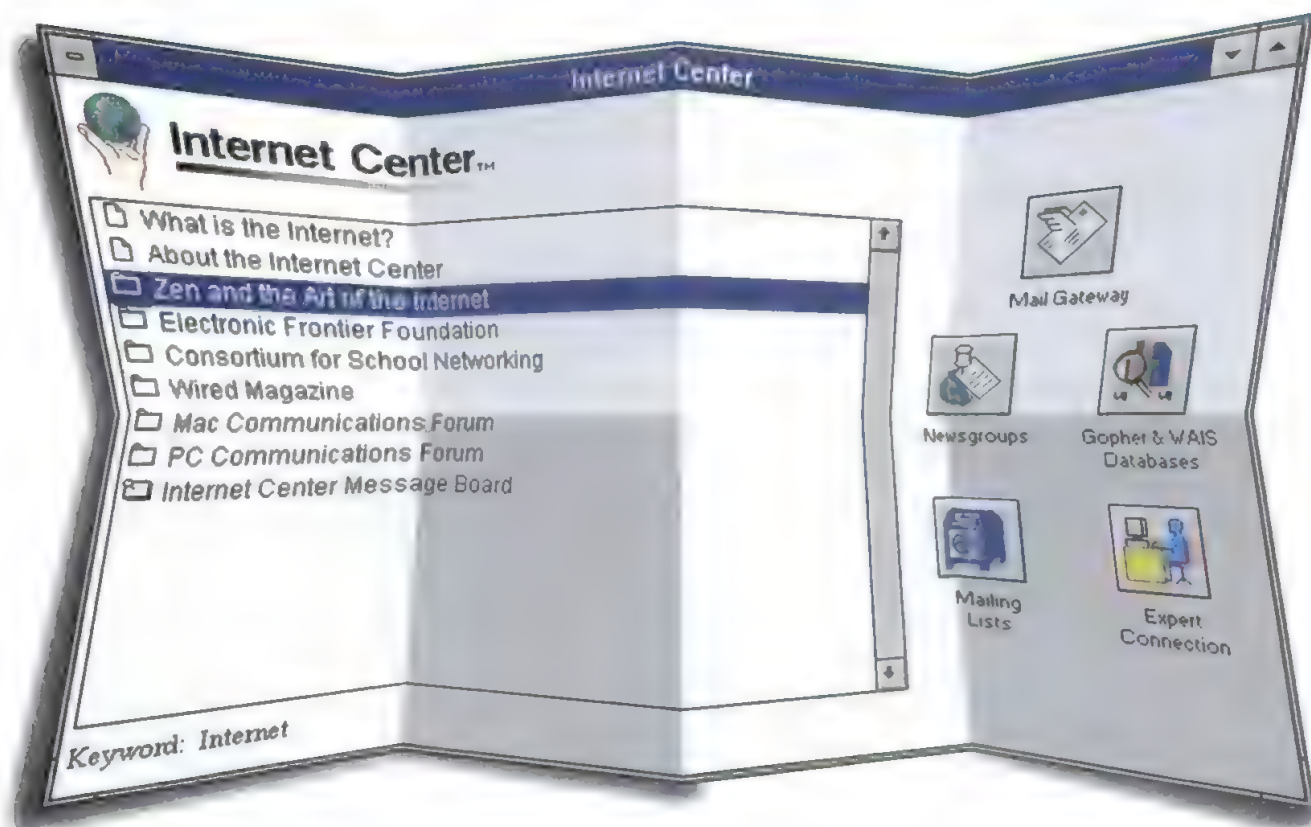
Close-Up's installation routine performs a number of diagnostic checks on your system and logs the results in a file that provides details about the comm port, IRQ status and potential conflicts, and the type of UART being used. The package also places copies of your AUTOEXEC.BAT, CONFIG.SYS, and SYSTEM.INI files into the log. This arrangement is particularly helpful for troubleshooting, because the log preserves a record of any problems that may have occurred during installation. Furthermore, since Close-Up does not replace any of your Windows drivers, it also doesn't need to modify your Windows .INI files.

WHAT YOU'LL FIND

The program consists of two primary modules, host and remote. You can run the remote module directly from Windows, but you must load the host module's DOS portion before you can launch that module from Windows. If you have memory constraints, you can use an alternate smaller version of the host, which is functionally equivalent to the full version, although it has no menus.

You can load the Close-Up host from Windows and continue to work in other applications, but the "real" host—the DOS TSR—must already be running in the background. The Windows front end, in reality a little applet with hooks to the TSR, doesn't provide access to host-mod-

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DOS: ☐ 5.25 ☐ 3.5

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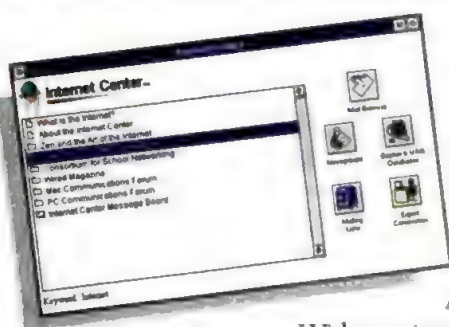
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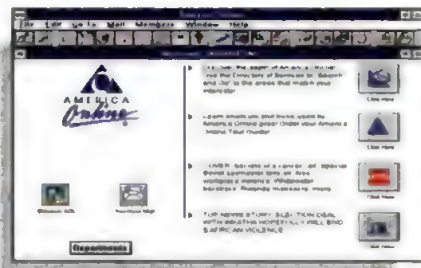


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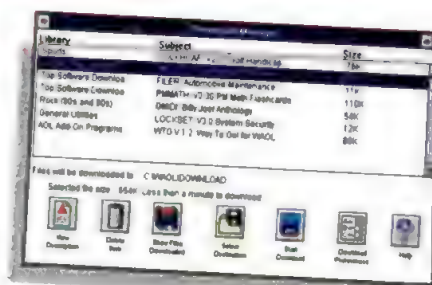
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Remote-Control Software

ule settings or other features, but it does offer a convenient button that releases the comm port for use by other applications.

To set or change basic parameters for the host module, you run **CHOST EDIT** from the DOS prompt. This allows you to

Close-Up's remote module is not a Windows program: When you launch a remote session from Windows, you are actually executing a Windows .PIF, which in turn launches the DOS package. This module is more complete than the Windows host module and lets you control all the parameters used by the remote session.

THE UPS AND THE DOWNS

Although Close-Up lacks support for Windows video resolutions of over 800-by-600, it offers an interesting solution to the unequal resolution problem. If you call in to a Super VGA host system from a VGA laptop, for example, Close-Up adjust the hosts display to the lower resolution, actually running it in standard VGA mode. And since Close-Up does not

among the slowest performers on our file-transfer tests. One nice precaution in the file-transfer utility is that, while a transfer is in progress, Close-Up writes to a temporary file. So if for any reason you abort the transfer or lose the connection, the file you may have been overwriting remains intact.

SAFE MEASURES

Close-Up's default host setup allows any user access to the system, but Close-Up makes you aware of this when you load the host. You can, of course, set password-controlled access limitations at any time. While Close-Up supports global file access by default, you can, in an additional modest measure, assign restrictions—send and receive, send only, receive only, or no access—to individual callers.

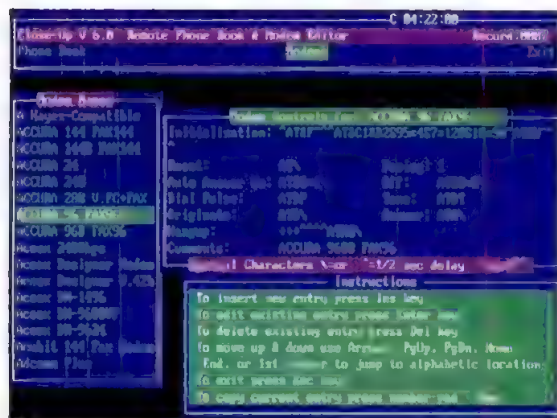
Norton-Lambert has done a nice job of substantially improving Close-Up from its previous version. The product's only significant drawbacks are its video resolution limitations and the lack of native Windows remote and file-transfer sessions. Close-Up's ease of use and top-notch video performance in Windows make it an excellent candidate for all users, except those that need to work in high-resolution video while running a remote machine.

Triton Technologies Inc.

CoSession for DOS CoSession for Windows

BY TED STEVENSON

CoSession for DOS, Version 7.0, is one of the remote-control-software world's most venerable and respected citizens—



Close-Up has the most extensive modem list in this roundup and provides extensive details about the setup strings.

create users and set passwords, file access security, and the Windows video resolution. There is also a modem editor that lets you completely customize the AT command settings to be used for any existing modem, as well as create settings for new or unsupported modems. Since Close-Up already provides support for over 690 different modems, you'll rarely need this feature.

▶ FACT FILE

Close-Up, Version 6.0

List price: \$199 **Requires:** 1 MB hard disk space, DOS 3.1 or later, on the host; 42K RAM, on the remote; 375K RAM, DOS 3.1 or later. **In short:** Although Norton-Lambert's Close-Up, Version 6.0, is still a DOS-based product, it runs Windows well, supporting up to 800-by-600 resolutions with 16 colors. The improved file-transfer capabilities allow you to tag files or directories to be transferred while the enhanced roving-callback capabilities strengthen Close-Up's security options. This package is well worth considering.

Norton-Lambert Corp., P.O. Box 4085, Santa Barbara, CA 93140, 805-964 6767, fax, 805-683 5679

SUITABILITY TO TASK

	Power	Ease of Use
Setup and configuration	EXCELLENT	GOOD
Remote control	GOOD	GOOD
Remote access	GOOD	GOOD
Security	GOOD	FAIR

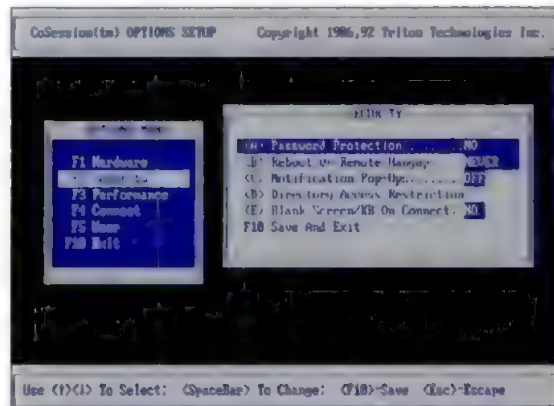
500-m reader service card

change your video drivers, you can run whatever resolution you choose when you're not running Close-Up.

Although Close-Up is not the most flexible package in terms of Windows video resolution, it is pretty speedy in remote Windows operations. It was in fact one of the fastest packages on our Microsoft Excel 4.0 Macro test, which primarily examines the video-transfer abilities of these packages under Windows.

In addition, Close-Up achieves its quick video transfers by a method the company calls *photographic memory*. Introduced in Version 5.0, this technology caches host screens on the remote system; when a screen needs to be displayed again, it is called from memory on the remote machine, rather than being transferred over the modem again.

Also improved is Close-Up's file-transfer module. With this DOS-based module, you no longer need to type the full path and filename; rather, you can tag single or multiple files or directories to be transferred. You can also use the file-transfer module to synchronize files or directories between machines. While the module is now easier to use, with more features than ever before, Close-Up was



CoSession for DOS's Host Options screen offers a variety of security settings, including notification of log-on attempts.

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and an Editors' Choice in our last remote-control story. But despite the advent of a brand-new Microsoft Windows version (CoSession for Windows, Version 1.0e), the product seems to have a stronger connection with the past than the future. In our last remote-control roundup, CoSession's Intelligent Graphics technology, which sends Windows GDI calls rather than bitmap data over the remote connection, gave the product an edge over competitors. In the interim, as our tests showed, the competition has pretty much caught up and eliminated this edge.

The DOS product lists for \$125 for either the host or remote, or \$179 for a "two-PC package" with both components. The Windows product is slightly more: \$129 per component; \$199 for the combination.

Installing either CoSession package is quick and easy. Whether you're installing the host or the remote in either DOS or Windows, the installation program states all changes it proposes to make to system startup files and gives the whereabouts and new names of the originals. Modem setup is quite simple. You merely identify your comm port, choose your modem (from a list of nearly 160), and set the transmission rate. The range of rates is wide enough to handle all current modems. While CoSession supports the 16550 UART, the software does not alert you if it has been detected.

WINDOW GAZING

You can run Windows on a CoSession host in either version of the product. With the DOS version, however, you need to choose a special Windows option during host installation, which makes the proper drivers available, then run a special Windows remote, which occupies so much memory that you won't be able to run much of anything on the remote system without unloading CoSession from memory. This said, things run smoothly and CoSession for DOS supports Windows screen resolutions of up to 800-by-600 with 16 colors.

CoSession for Windows supports 256-color displays of up to 1,280-by-1,024 (we tested up to 1,024-by-768). If the remote system is running a lower resolution than the host, the host screen is windowed and

Remote Access

by Kathleen Caster

There's nothing like remote-control software if you actually need to run applications or do technical troubleshooting. But if, like most users, you connect remotely only to upload or download files, you might want to consider a product that provides file access without the technical hassles.

The tried-and-true remote file-transfer package is the DOS-based, \$169.95 LapLink V from Traveling Software (206-483-8088). LapLink began life as a way of moving files between desktop and laptop via direct-cable connections. It now does the same over Novell networks and phone lines via modem. (A Windows version, due out in late summer, will integrate remote control.)

LapLink provides log-on security to protect your system from unauthorized use, data compression to speed your file transfers, and a generous set of file-management features. You can copy, move, rename, and delete files and directories.

Working with files in multiple locations can give rise to version-control and directory-synchronization problems; LapLink addresses these adeptly. It offers as Copy by Date option; bidirectional synchronization; Cloning, to ensure that the contents of directory A are reflected in directory B (but not the reverse); and a Refresh option, which copies from A to B only newer versions of files stored in both directories.

Other vendors offer remote file-access products. For speedy modem file transfers in DOS or OS/2, Louis E. Wheeler (805-481-5687) offers the \$119 Remote-Console, Version 4.0. Other DOS-based packages include the \$49.95 Doorway, Version 2.22, from TriMark Engineering (615-966-3667) and the \$40 RemoteRetrieve, Version 1.0, from OutPost Software (408-736-1070).

For the option of working in Windows, DOS, or both, check out the \$99.95 HotDisk, Version 1.0, from Smith Micro Software (714-362-5800), in beta at press time.

Windows-only remote file-transfer packages include the free (\$9.95 for shipping and handling) Filex for Windows, Version 1.0, from Durand Communications Network (800-999-7771) and the \$169.95 SmartSync, Version 2.0, from Nomadic Systems (800-432-1293). SmartSync (in beta at press time) works over modems and LANs. It can send whole files or just changes to those files.

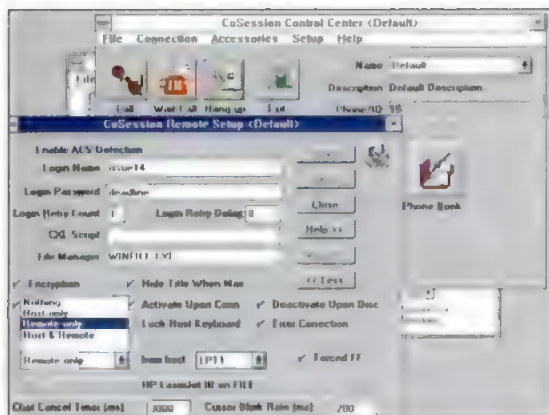
Remote file-transfer capabilities have become fairly common in full-featured communications packages. Using a standard terminal emulation, you can set your system in a host call-waiting mode. You can then dial into that system from a remote computer as easily as you would dial into CompuServe.

The \$149 HyperAccess for Windows, Version 1.02, and \$99.95 HyperAccess/5 for DOS, Version 3.1, from Hilgraeve, (313-243-0576) are good examples. From Datastorm Technologies (314-443-3282) come another pair of communications packages with remote host capability: the \$179 Procomm Plus for Windows, Version 1.02 (Version 2.0 was in beta at press time), and \$129 Procomm Plus for DOS, Version 2.01.

PowerLine, Version 1.2, from Enable Software (800-888-0684), is a \$149 Windows-based communications package that provides not only remote file-transfer capabilities but also intuitive version control.

Finally, a file-synchronization package can help keep you organized. For this, check out PowerSync, Version 1.10, from LinkPro (714-854-3322). The \$89.95 Windows-based package works on top of your communications program. □

Remote-Control Software



CoSession for Windows' expandable Remote Setup screen manages many system settings, including print direction (shown here).

scroll bars allow you to move to all parts of the host screen. The performance penalty for moving beyond standard VGA resolution is modest.

You can run full-screen DOS sessions from the Windows remote package either in Windows or by shelling out to the DOS prompt and loading the app. You can also exit Windows or connect from the Windows remote to the DOS TSR and run DOS apps.

If the remote is running Windows, you can work with the host in a window or on the full screen. A hotkey drops you back from full-screen to windowed operation.

TRANSFERS AND SECURITY

CoSession's file-transfer utility is one of its best features. The utility is quick and offers not only the basics but also several enhancements, including Make Directory, Local Copy, a file viewer, and Update, a crude form of directory synchronization that brings a host directory up to date with its equivalent on the remote. Batch transfers are monitored by progress indicators for each individual file and for the batch as a whole.

You can create a list of drives and directories for file-transfer activities (the default is unlimited access). You can also specify *send*, *receive*, *send/receive*, or *no access* to the files in those directories, but not to individual files. If you load the optional Safeguard utility, the access restrictions will apply to operations in DOS application sessions as well as to CoSession file transfers.

The DOS and Windows packages both offer basic password security, wherein a log-on name and password are entered into host and remote phone-book entries. You can also set a Master password that controls changes to the phone-book entries. If the Password Protection option is checked in the host package, CoSession automatically compares the caller log-on entry with the host's log-on parameters, making the connection if they agree, dropping it if they don't. When Password Protection is set, you can also easily set up a callback—to a

single, predefined number.

You can blank the host's screen on connection and lock its keyboard but not

disable its mouse. Both versions of CoSession have a *billing log*, which, when invoked, records connections and their durations, but no more.

NET WORTH

CoSession for DOS obligingly lets you connect to a network after you've loaded the host TSR. The Windows version is not so accommodating: It's net first, CoSession second. Thereafter, it handles the accessing of network drives with aplomb. Neither current CoSession package can communicate via network protocols—although the Windows product should have IPX support by the time you read this, with more to follow shortly—nor does either offer more than the most rudimentary terminal-emulation capabilities. This is probably not the package to choose if you want to connect to mainframes or on-line services and move files using standard file-transfer protocols.

Remote access is possible with CoSession, but it's a bit convoluted. You must run an extra 37K utility on both ends of the connection, and with the DOS package you must initially run a separate setup utility to establish the drive mappings. In the Windows package, drive mapping is easier to set up.

CoSession can, beyond question, handle the basic jobs of remote control and file transfer reliably and with reasonable efficiency. But there seems to be no compelling reason to choose this package if you don't already use it in your organization.

► FACT FILE

CoSession for DOS, Version 7.0 CoSession for Windows, Version 1.0e

List price: DOS version, \$179, Windows version, \$199

DOS version requires: On the host: 65K RAM, DOS 3.1 or later; on the remote: 125K RAM, 1.5MB hard disk space, DOS 3.1 or later.

Windows version requires: 74K RAM, 1.5MB hard disk space, Microsoft Windows 3.1 or later.

In short: Though Triton Technologies' CoSession was an Editors' Choice in our last remote-control story, the new version failed to reach such a high mark. CoSession is a solid performer with a respectable feature set—it can certainly get basic remote-control jobs done with reasonable efficiency, but there's no compelling reason to choose this package.

Triton Technologies Inc., 200 Middlesex Tpke., Iselin, NJ 08830, 908-855-9440, fax, 908-855-9608

SUITABILITY TO TASK (DOS)

	Power	Ease
Setup and configuration	FAIR	GOOD
Remote control	GOOD	GOOD
Remote access	FAIR	FAIR
Security	GOOD	FAIR

SUITABILITY TO TASK (WINDOWS)

	Power	Ease
Setup and configuration	FAIR	FAIR
Remote control	GOOD	FAIR
Remote access	FAIR	FAIR
Security	GOOD	FAIR

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Symantec Corp.

EDITORS' CHOICE

**Norton pcAnywhere
for DOS**

EDITORS' CHOICE

**Norton pcAnywhere
for Windows**

BY TED STEVENSON

Think of them as Range Rovers of the PC remote-control software world. Symantec's Norton pcAnywhere for DOS, Version 5.0, and pcAnywhere for Windows, Version 1.0, can comfortably cruise the streets and highways of on-line communications, but these packages are built to handle a range of exotic terrains where



Monitor disk space down the hall.



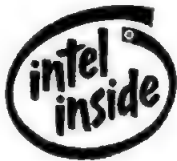
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HP NetServer LC • 66-MHz Intel Pentium processor, 100-MHz IntelDX4 processor, 66-MHz Intel486 DX2 processor • Automatic Server Restart • 8-MB and 16-MB RAM standard, 192-MB maximum • Up to 256-KB write-back cache • 1 PCI, 1 PCI/EISA-combo, 4 EISA I/O slots • 5 mass storage shelves • Integrated EISA Fast SCSI-2, IDE and video controllers • Designed-in security, serviceability, and cooling features • Tested and certified on all major network operating systems

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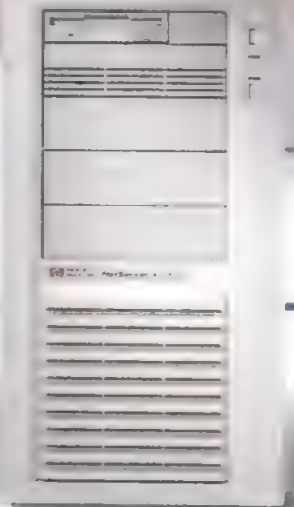
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INTERGRAPH
COMPUTER SYSTEMS

CIRCLE 048 ON READER SERVICE CARD

Remote Control via LAN

By Amarendra Singh
and Ted Stevenson

Remote control of PCs is by no means limited to dial-up connections. The market boasts many products that allow one LAN workstation to control one or more others using IPX, NetBIOS, or other networking protocols. While many of these are components of LAN-management packages, some of the dial-up products in this roundup include this kind of networking capability or have sister products that run across a LAN. We informally examine a group of LAN/remote products with an eye to understanding their capabilities and gauging their usefulness.

NEW BALL GAME

Two of the main reasons for using dial-up remote control—running applications unavailable locally and accessing files stored in another location—really don't apply in a network context. In practice, the principal uses for network remote-control software are troubleshooting or other technical support and training. In connection with the latter, support for one-to-many connections—usually, making a host screen visible to multiple remote users—comes into play, but not all the LAN-based products support this.

The packages we looked at (LAN products from vendors represented in our main story, plus one LAN-only package, Funk Software's Proxy) are uniformly easy to install, and connections are invariably quick and easy to establish. The similarity among the packages often ended there. Here's a product-by-product summary of what we found:

- **Carbon Copy for DOS, Version 6.1**, from Microcom (800-822-8224). This package comes in the same box as its asynchronous counterpart, but it's a separate executable with different features. Through a special setup

option, you can enable one-host-to-many-remote connectivity. By contrast, its remotes cannot connect with multiple hosts. But switching connections between separate hosts requires just a few keystrokes.

This was the only package we saw that allowed a remote user to view a host without the host's being aware of the connection. (Most other packages at least popped up an alert.)

Although this "feature" can be overridden by host setup options by blanking out remote users (and a remote user could never compromise host passwords or security), it nevertheless raises

the disturbing specter of possible invasion of privacy.

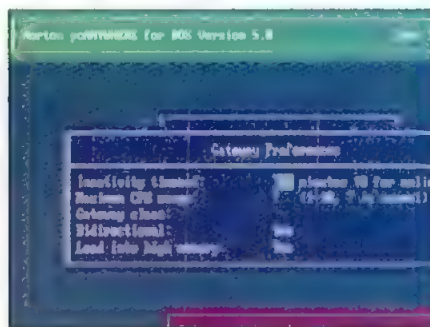
- **Carbon Copy for Windows, Version 2.0**, from Microcom (800-822-8224). This package is basically another feature of the dial-up product: Toward the end of the install, you simply choose *network* as your communications option. The product's clean interface and feature set translate nicely to a LAN, but the package supports one-to-one connections only.

- **Close-Up/LAN**, from Norton-Lambert (805-964-6767). Installing this product involved nothing more than copying the host and remote .EXE files to a network or local hard disk. Close-Up/LAN uses your network logon as your machine name. Pulling up the program's menu, you can see the other workstations available for connections. Close-Up/LAN supports one-to-many connections in both directions. When a remote is connected to multiple hosts, the remote user

toggles among them, controlling each in turn. With one host and many remotes, the program acts more like a broadcast package, letting all remotes see what's happening on the host screen.

- **Norton pcAnywhere for DOS**, from Symantec (800-441-7234). This package is designed for quick and simple one-to-one connections only. One of

pcAnywhere's most interesting features is its ability to launch a gateway, through which a network workstation can provide access to a modem for both incoming and outgoing connections, while leaving the workstation free for general use.



Norton pcAnywhere for DOS's Gateway Preferences dialog box lets you set options for establishing remote LAN links.

- **Proxy, Version 1.02**, from Funk Software (800-828-4146). While this Windows product does not have a dial-up counterpart, we looked at it to get at least some idea of available LAN-only options. Interestingly, Proxy has no interface, in the normal sense of the word. You operate the *master* (remote) from the Windows control box, where you'll find Connect, Task, and Settings options. These allow you to create a name for the host and set a password, set host access privileges, or limit host availability to specific times. The Task feature lets you automate connections to specific apps on specific host systems.

Proxy appeared to run Windows faster than any of the other packages in our roundup, but only in one-to-one connections. To get the effect of one-remote-to-many-host connections, simply run multiple sessions of Proxy remote, each to a single host. □

Let's talk scanned image quality.

Test 1 COLOR REGISTRATION ACCURACY



MICROTEK SCANMAKER IIsp

A good test for RGB color registration is to scan black and white line art in RGB color mode. When magnified and displayed on the monitor you should not see red, green or blue pixels, only gray and black. Microtek's ScanMaker IIsp image on the left shows no red, green or blue pixels. Hewlett Packard's ScanJet IIcx, however, shows too many red, green and blue pixels.

BEFORE YOU BUY ANY SCANNER, TAKE A GOOD, HARD

Before you lay down your hard-earned bucks for a single-pass color desktop scanner, here's a simple test you can perform to see for yourself how well it handles color registration.

Scan black and white line art in RGB color mode. Then enlarge and examine the results.

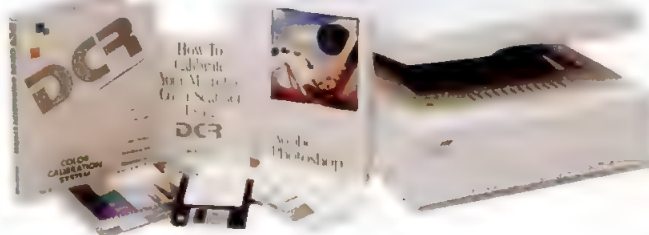
If the colors are properly aligned — or “registered” — the lines will look black. If you see dots of red, green or blue at the edge, the scanner's color registration leaves something to be desired.

SEE FOR YOURSELF

In a recent direct comparison between the Hewlett-Packard ScanJet IIcx and the Microtek ScanMaker

IIsp, the ScanMaker clearly shows superior color registration. The H-P ScanJet IIcx, well, leaves something to be desired. And because poor registration is only one factor that causes inaccurate color, it further degrades color quality when accuracy problems already exist. So color registration is only one of the quality checks you should be making if you want the best scanner for your money.

Another is color accuracy — how close does the color of the scanned image come to the color of the original? The Microtek ScanMaker IIsp uses an award-winning system called Dynamic Color Rendition (DCR) which automatically calibrates and



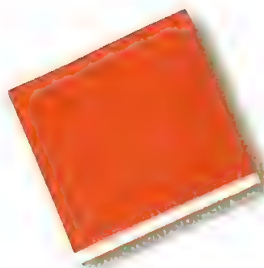
The scanner to ask for, Microtek's ScanMaker IIsp, comes complete with Adobe Photoshop LE for Windows or Macintosh and the DCR color calibration/correction system including software and an IT-8 calibration target. Shown with optional Transparent Media Adapter. Optional Automatic Document Feeder also available.

Test 2

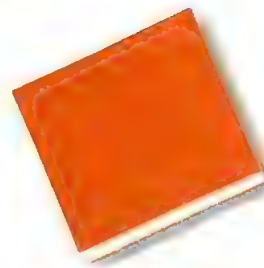
COLOR ACCURACY



H-P SCANJET IIcx



PROCESS MAGENTA



A WARM RED



MICROTEK IISp



H-P IIcx



MICROTEK IISp



H-P IIcx

Color accuracy is important in most of the images we scan. To test color, we scanned color swatches from an industry standard color-matching system. Once again, Microtek's ScanMaker IISp easily outclassed the well-known ScanJet. The disparity is even more apparent when the Transparent Media Adapter is used. H-P's stationary "light table" light source results in uneven accuracy, while Microtek's moving light source gives consistently more accurate color.

LOOK AT REGISTRATION AND COLOR ACCURACY.

corrects colors to make them virtually indistinguishable from the original.

To prove it, we scanned a 100% magenta color swatch on the ScanJet IIcx and the Microtek ScanMaker IISp. The results, as you can see, show the ScanMaker IISp's color accuracy is superior to H-P — or anyone else. In fact, in a scanner comparison published in the February 8th edition of *PC Magazine*, the editors said, "...the ScanMaker IISp's color output was clearly the best of any scanner in our survey."



Microtek ScanMaker IISp

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If you're considering a scanner — anybody's scanner — don't write the check until you've seen the Microtek ScanMaker IISp. For your free copy of *The Scanned Image* (an easy introduction to scanners), more information or to find out where to see the IISp for yourself, call us at **800/654-4160** or fax a request to 310/297-5050.

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CIRCLE 091 ON READER SERVICE CARD



Remote-Control Software

family sedans cannot hope to operate. They can tackle remote control and file transfers not only over dial-up connections but also with other kinds of hosts (mainframes, BBSs, and on-line services). Also, both can do over a network or direct serial link just about anything they can do via modem.

SIMPLY DIFFERENT

Once you've completed the no-sweat installation process, you'll be struck by the products' simple and unusual look. The main screen of pcAnywhere for Windows has three big icons that give you one-click access to the product's most common tasks: Be a Host PC, Call a Host, and Call an On-line Service. Each icon provides access to tools related to the task at hand, including hardware and software setup. Less-standard operations—setting up gateways and accessing utilities—are controlled via pull-down menus. In the DOS product, *Gateways* and *Utilities* join

the three primary tasks as entries on the main menu. In both packages, though, you may find some of the more advanced settings, such as limiting the number of log-on attempts allowed, difficult to locate.

pcAnywhere for DOS allows either background or foreground file transfers, and offers many file-management options (including Make Subdirectory, Local Copy, and Delete Selected Directories) and quick transfer rates. The foreground utility, a separate executable, interrupts host operations but saves the 17KB of memory required to keep the background transfer capability, well, waiting in the background. Simple read-write privileges can be set for each caller, but can be applied only per physical drive type—floppy disk, fixed hard disk, or network—not for specific volumes or directories. In the Windows product, a File Manager look-alike handles file transfers. (Windows lets you minimize the module, which allows for background transfers.) This package offers *no* read-write or other file security.

Both versions do, however, offer drive remapping. Mapping can encompass network volumes as well as drives physically present in both PCs.

You can keep logs of both remote and host connection activities; these can include much detail, such as the identity of the caller, the type of connection (to host or on-line service), failed log-on attempts, cause of session end, billing ID codes, and more. Log information can be formatted into reports for display or printing, and can be archived.

SECURE IN ITS OPTIONS

Connections to a host in either pcAnywhere package are protected by passwords stored in the Caller Information Configurations. You can add configurations and passwords for specific callers, and any of these can invoke callbacks. If you leave the callback number blank, the host will prompt the caller for a call-

▶ FACT FILE

Norton pcAnywhere for DOS, Version 5.0
Norton pcAnywhere for Windows, Version 1.0

List price: \$179 **DOS version requires:** 888KB RAM, 2.7 MB hard disk space, DOS 3.3 or higher **Windows version requires:** 275KB RAM, 3.2MB hard disk space, Microsoft Windows 3.x **In short:** pcAnywhere for DOS and Windows may not be the fastest or most elegant remote-control packages going today, but they're among the most versatile and robust products around. Both products offer more than the usual mix of features, including several layers of security, various terminal emulations and file-transfer protocols. Both are also speedy performers, especially the DOS product.

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014-2132, 800-441-7234, 408-253-9600, fax, 800-441-7234

SUITABILITY TO TASK (DOS)

	Power	Ease
Setup and configuration	EXCELLENT	GOOD
Remote control	GOOD	GOOD
Remote access	GOOD	GOOD
Security	FAIR	GOOD

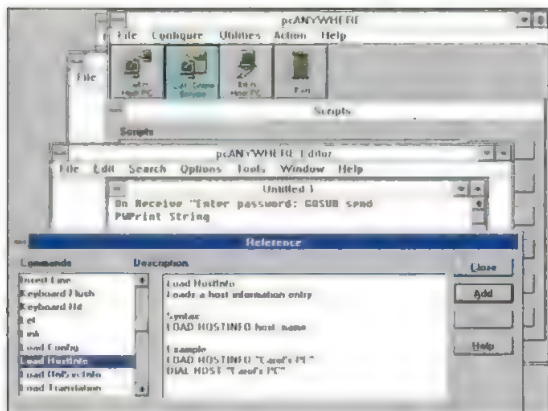
SUITABILITY TO TASK (WINDOWS)

	Power	Ease
Setup and configuration	GOOD	GOOD
Remote control	GOOD	EXCELLENT
Remote access	GOOD	EXCELLENT
Security	FAIR	GOOD

502 on reader service card



pcAnywhere can automatically execute a log-on or session script for any session configuration.



Scripting in pcAnywhere for Windows is facilitated by a Command Reference that provides correct syntax and usage examples.

back number when the connection is made, which in effect enables roving callbacks. Finally, you can lock the host system while it's in call-waiting mode, a very sensible security feature that every remote-control package should have, but which only this one does have.

pcAnywhere is unusual in that it lets you connect with a network either before or after loading the remote-control software. While not a make-or-break feature, this provides flexibility to on-line sessions.

Moreover, pcAnywhere provides hardware setup routines for a number of non-dial-up types of connections, including direct serial (either via null-modem or leased line), Interrupt 14 (for modem sharing over networks), and ACS (asynchronous communications server) using IPX, NetBIOS, or VINES protocols. Fi-

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Latin,

my parents,

how tofu can be so popular,

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more money than doctors,

why everybody makes

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NEC

CIRCLE 217 ON READER SERVICE CARD

▪ Citrix's WinView: *Power to the People*

By John Clyman

If you need to provide remote access to multiple users without spending a fortune on hardware, look into Citrix Systems' WinView for Networks, Version 2.21. WinView turns a 386 or higher PC into an application server into which multiple users can simultaneously dial. Besides avoiding the expense of dedicating a pool of PCs as remote-access hosts, WinView provides ironclad security, centralized administration, and seamless integration with Novell's NetWare networks. As its name implies, WinView is optimized for Windows remote access; however, it also supports DOS and OS/2 character-based applications.

Like NetWare, WinView's price depends on the maximum number of simultaneous users it can support. Prices start at \$2,645 for a 10-user configuration. To provide access to more than two dial-up users, you'll also need to equip the application server with a multiport communications adapter, which typically costs around \$1,000 for a 16-port model. WinView also supports users connected directly to the server, either via serial connections on comm ports or across a network. A basic configuration requires 8MB of RAM on the server plus 3MB for each simultaneous Windows session or 1MB for each simultaneous DOS session you need to support.

WinView runs on a customized version of OS/2 2.0. Installation is almost completely automated; setting up user log-ons and loading applications is similarly painless. The task won't prove daunting to anyone who's ever administered a NetWare LAN. Moreover, the documentation is comprehensive and well written.

WinView takes security seriously. The package supports passwords, roving callbacks, access-time restrictions, limits on call duration, and expiration dates for user accounts. Users

can be granted or denied specific types of access to individual drives, directories, or files, and users' allocation of system resources, such as virtual memory, can be limited. You can let WinView use log-ons and permissions stored on a NetWare server.

WinView can be configured to retain a remote user's session for a number of minutes after an unexpected disconnect, so if the user logs back on quickly enough, he can resume working where he left off. And because WinView isolates each user in his own virtual machine, one user's crashes won't bring down the whole system—a problem with most stand-alone remote-access packages.

EASY ACCESS

Remote users dial into a WinView server using the included Remote Link software, which requires only a 286-based PC with 640K of RAM (2MB recommended) and about 1MB of hard disk space. Connecting to a WinView server simply involves selecting an entry in Remote Link's phone book and logging on with a user name and password. Then, the WinView application server looks like a dedicated host PC. By default, WinView automatically runs the Windows Setup program the first time each user logs on.

WinView's customized version of Windows 3.1 lets every user set up an individual Program Manager group and configure Windows as desired. But you only need one copy of Windows executable files on the server, which reduces disk space requirements. WinView can provide a similar capability with individual applications. For instance, the system administrator could install a word processor and

make it accessible to multiple users.

Remote users can upload and download files from the server with a provided file-transfer utility. Users can also redirect their print jobs through the WinView server, where these jobs can be spooled either in the order received or by size (smaller jobs first).

WinView's performance is exemplary: In anecdotal testing using a Compaq Deskpro 66M 486DX2/66-

based server with 16MB of RAM and Compaq Deskpro/M viewer workstations with 8MB of RAM, connected over a 14.4-Kbps modem link, DOS and Windows hosts responded snappily

even when multiple connections were active. And since WinView performs all processing on the server and simply sends screen updates to the viewers, you can improve performance of processor-intensive tasks by putting a faster CPU on the back end.

FEW LIMITATIONS

WinView's limitations are few. The program doesn't let remote users run Windows apps that require VxDs, but that shouldn't be a problem for most users. WinView also won't let remote users work at resolutions higher than their own equipment supports; it cannot, for instance, window the host screen.

On the whole, WinView provides a stable, easily manageable solution for supporting multiple remote users at a relatively low total system cost. □

► **WinView for Networks, Version 2.21.** List price: 10-user version, \$2,645; 5-user add-on pack, \$695. Citrix Systems Inc., 210 University Drive, #700, Coral Springs, FL 33071; 800-437-7503, 305-755-0559; fax, 305-341-6880.

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WinView provides an easy, inexpensive solution for supporting multiple remote users.

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- Microsoft Excel
- Paradox 3.x, 4.x
- Btrieve 5.x, 6.x
- ASCII
- Clipper Summer 87.5.x
- NetWare SQL
- Package includes Powersoft™ and Q+E™ drivers

Remote-Control Software

nally, a pcAnywhere installation can be configured as a LAN gateway, translating between asynchronous and network communications protocols and thus providing dial-up remote-control and file-transfer capabilities to network users who don't have modems and network access to those that do.

In a less exotic vein, pcAnywhere offers more than 15 terminal emulations and a generous selection of asynchronous file-transfer protocols in a reasonably sophisticated interface to facilitate logging onto mainframes and dial-up BBSs and other on-line services.

SCRIPTED TASKS

pcAnywhere provides powerful session-scripting tools. The DOS product's Automated Procedures allow unattended logons, file transfers, and execution of DOS commands on both the remote and host. Using the language's 150-plus commands, you can craft scripts that automate highly complicated activities. The Windows product simplifies script creation with an on-line command reference that explains commands and syntax and gives usage examples and an Assist dialog that takes parameters and information that you supply and inserts them into script commands in proper syntax.

Both pcAnywhere products let you record on-line sessions for later playback. This feature is designed for tech support or help-desk personnel (so they can examine a remote user's problem in detail) or for instructional situations where a learner might want to carefully review a procedure demonstrated by a remote trainer.

pcAnywhere, in both of its guises, may not be the fastest or most elegant remote-control package going (although it has strong claims in both areas), but it is perhaps the most versatile and robust product available. If tight security is vital to your organization, however, pcAnywhere may not be up to snuff.

Software Corporation of America

● PolyPM/2

BY LAURA COX

Software Corporation of America's PolyPM/2, Version 2.20, is a 32-bit OS/2 remote-control product that fully supports

OS/2 2.x and brings a variety of connectivity options to users of IBM's operating system. The standard version, with both remote and host components, costs \$295; individual remote and host components are \$195 each and gateways are available free of charge. Enterprise-wide licenses start at \$4,000 for 25 users. Installation is easy, but users will need to consult the manual for proper setup.

LEARNING THE ROPES

PolyPM/2 refers to the host user as the *pupil* and the remote user as the *teacher*. These terms point to the package's appropriateness for training and help-desk situations, to which PolyPM/2 is especially geared. Remote teachers operate under OS/2 only, but can connect to OS/2, DOS, and Windows hosts. Running under OS/2 gives PolyPM/2

some advantages. For example, a teacher can control multiple pupils from the same desktop without confusion. Host machines appear in separate windows on the remote user's desktop.

PolyPM/2 works over modem and null-modem connections, as well as across a LAN through NetBIOS or X.25 and APPN connections (OS/2 only).

► FACT FILE

PolyPM/2, Version 2.20

List price: \$295. **Requires:** On the host: 500K RAM, 900K hard disk space; on the remote: 170K RAM, 800K hard disk space, OS/2 2.0 or later. **In short:** PolyPM/2 is a native OS/2 remote-control product that fully supports the Workplace shell and takes advantage of OS/2's multithreading capabilities. The package's many connectivity options and extra features make it a must-have for OS/2 users who want remote control, but performance is slow and the package's file-management capabilities are lacking.

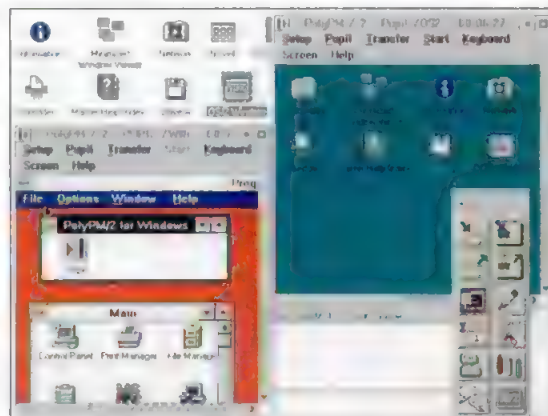
Software Corporation of America, 100 Prospect Street, South Tower Plaza Level, Stamford, CT 06901, 203-359-2773, fax, 203-359-3198

SUITABILITY TO TASK

	Power	Ease
Setup and configuration	FAIR	FAIR
Remote control	FAIR	GOOD
Remote access	FAIR	GOOD
Security	GOOD	FAIR

374 On reader service card

Asynchronous remote access is slow and screen updates on a typical 9,600-bps connection take 3 or 4 seconds. PolyPM/2 defaults to proprietary compression and flow control during asynchronous communications but users can change modem



Thanks to OS/2's multitasking capabilities, a remote user in PolyPM/2 can dial into multiple pupils (hosts) simultaneously.

settings if they wish. Remote users can view a host in monochrome to speed operation and can control host OS/2 sessions without the graphical overhead of the desktop. Software Corp., nonetheless, recommends high-speed modems capable of at least 9,600-bps without compression. PolyPM supports over 70 modems, and users can obtain additional modem configurations by calling technical support.

SAFETY AND FILE TRANSFERS

PolyPM/2's security starts with the critical task of registering remote users with hosts. The host cross-checks a remote user's log-on name and serial number at the time of connection, denying access if log-on parameters don't match. (There was one anomaly: We couldn't make a connection until the log-on name was in upper case). In order to safeguard critical host settings, a connection is dropped when a remote user tries to change particular host settings. Remote and host users can password-protect their machines and hosts can require passwords for remote users wishing to connect.

PolyPM/2's file-transfer utility gives remote users the ability to upload and download files. Remote users can copy system and hidden files and upload or download entire subdirectories, letting

LAN administrators upload the latest software to host machines with ease.

Background file transfers are performed on a separate thread under OS/2, but performance was poor on our file-transfer tests. One nice feature is the ability to resume file transfers automatically when a connection is broken; PolyPM/2 can disconnect users after successful file transfers. Also, remote users connected to OS/2 and Windows hosts can upload and download clipboard information.

IMPRESSIVE EXTRAS

Like all of the other packages in this roundup, PolyPM/2 allows unattended access to a host. PolyPM/2 also has an optional feature that allows the host to be issued a warning and accept or decline access to the system by a remote user. This is especially useful in a help-desk environment.

PolyPM/2 takes a different approach to callbacks in that the callback number is conveniently controlled by the remote user rather than by the host. PolyPM/2's tight security measures make this implementation viable.

With the Stretch option, remote users can view the entire desktop of a host running at high video resolutions (up to 1,280-by-1,024 with 65,000 colors), albeit with substantial sacrifices in clarity. Users can also simply scroll the screen, as in most of the other packages, and can record sessions to a log that tracks file transfers, chat sessions, and the time and duration of calls. Finally, a Marker feature lets remote users annotate the host's desktop.

As an added bonus, PolyPM/2 provides teacher and pupil gateways that allow connections between LAN users running NetBIOS and remote users. Version 2.3, due out shortly, will add support for IPX and TCP/IP. Other features expected in Version 2.3 include enhanced connection options, a scripting language, and an improved file-transfer utility.

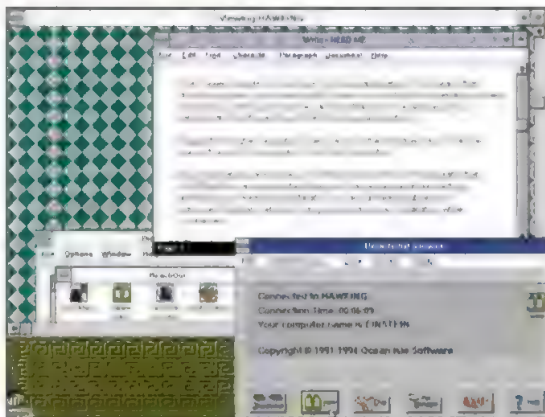
In PolyPM/2, Software Corp. has a strong, competent package with full OS/2 support. The package's many connectivity options and extra features make it ideal for a help-desk environment and will nicely serve the needs of OS/2 users in search of a remote-control package.

Ocean Isle Software

• ReachOut Remote Control

BY JOHN CLYMAN

Ocean Isle Software's ReachOut Remote Control, Version 4.02, turns heads for a reason. For one thing, it boasts myr-



The ReachOut remote creates a window for high-resolution host screens. Installing ReachOut doesn't alter system-configuration files.

riad above-average features, such as excellent modem diagnostics and an unintrusive installation. At the same time, ReachOut rounds up numerous standard features—from roving callback to drive mapping—while putting in impressive test performance. Unfortunately, the \$199 package, which supports both DOS and Windows host and remote modules, is somewhat rough around the edges. Its security provisions are incomplete and its user interface is somewhat unintuitive. Still, the software's strong core technology and top-flight performance make its quirks easy to overlook. On our tests, ReachOut was often one of the fastest products.

AT THE START

Installing ReachOut is nearly effortless. The software does not automatically detect which port your modem is attached to, but it does determine whether a 16550 UART is present.

Installation leaves critical system files, including SYSTEM.INI and WIN.INI, untouched on both the host and remote machines. To use the software, you simply run a batch file that loads the necessary modules. By default, the program's TSRs are loaded low and consume about 38K of

RAM; you can, however, unload them after the session is complete.

ReachOut's Windows remote lets you connect to a host computer running video resolutions of up to 1,280-by-1,024, regardless of the remote's resolution; when necessary, the remote simply places the host screen in a window with scroll bars.

The software supports up to 256-color host displays. The DOS remote also supports Windows, including full-screen DOS sessions within Windows, at VGA and Super VGA resolution. ReachOut handles DOS graphics quickly and accurately.

STANDARD FEATURES

A Clipboard-sharing feature in the Windows remote makes it easy to transfer data from Windows applications running on one machine into Windows applications on the other. The package also includes both DOS- and Windows-based file-

transfer utilities, which have only one serious limitation: They lack a cumulative progress display to help you monitor multiple-file transfers. The file-transfer

▶ FACT FILE

ReachOut Remote Control, Version 4.02

List price: \$199 **DOS version requires:** 1 5MB hard disk space, DOS 3.1 or later **Windows version requires:** 2 5MB hard disk space; on the host: 15KB RAM; on the remote: 300K RAM, Microsoft Windows 3.x **In short:** Ocean Isle Software's ReachOut provides a strong set of features, including drive mapping, DOS- and Windows-based file utilities, and roving callback. The package is very fast and installation is straightforward. Security is among its weaker features, but the package still goes farther than most. ReachOut is definitely worth trying.

Ocean Isle Software, 1201 19th Pl., Vero Beach, FL 32960, 800-677-6232, 407-770-4777, fax: 407-770-4779

SUITABILITY TO TASK

	Power	Ease
Setup and configuration	GOOD	GOOD
Remote control	GOOD	GOOD
Remote access	GOOD	GOOD
Security	GOOD	GOOD

504 on reader service card

► **S U M M A R Y O F F E A T U R E S**

Remote-Control Software



Products listed in alphabetical order ■ = YES □ = NO	Carbon Copy for DOS	Carbon Copy for Windows	Close-Up	CoSession for DOS	CoSession for Windows	Norton pcAnywhere for DOS	Norton pcAnywhere for Windows	PolyPM/2
List price	\$199	\$199	\$199	\$179	\$199	\$179	\$199	\$295
Native interface	DOS	Windows	DOS, Windows	DOS	Windows	DOS	Windows	OS/2
Extended / Expanded Memory								
Host supports expanded or extended memory	■	■	■	■	■	■	■	■
Remote supports expanded or extended memory	■	■	■	□	□	□	□	N/A ^①
Can remove TSRs without rebooting	■	□	■	■	■	■	■	□
File Transfer								
Can work in background	□	■	■	■	■	■	■ (via Windows)	■
Compresses files	■	■	■	■	■	■	■	■
Can tag and transfer multiple files	□	■	■	■	■	■	■	■
Will prompt before overwriting	■	■	■	■	■	■	■	■
File management:								
Delete	N/A ^②	■	■	■	■	■	■	□
Local copy	N/A ^②	■	□	■	■	■	■	□
Make directory	N/A ^②	■	■	■	■	■	■	□
Rename	N/A ^②	■	■	□	□	■	■	□
Other	N/A ^②	None	None	File viewer	Move	Delete selected directories	Delete selected directories	None
Can turn off error checking	□	□	■	■	■	□	□	■
Nonproprietary file-transfer protocols supported	Xmodem, Ymodem, Zmodem	Xmodem, Ymodem, Zmodem	Xmodem	Xmodem	None	Kermit, Xmodem, Xmodem-CRC, Xmodem-1K, Xmodem-1KG, Ymodem, Ymodem-G, Zmodem	Kermit, Xmodem, Xmodem-CRC, Xmodem-1K, Xmodem-1KG, Ymodem, Ymodem-G, Zmodem	None
Drive mapping (redirecting) supported	□	□	□	■	■	■	□	□
Directory synchronization	□	□	■	■	■	□	□	□
Security								
Log-on is password-protected	■	□	■	■	■	■	■	■
Separate password controls changes to setup	□	■	□	■	■	■	■	■
Passwords are encrypted	□	□	■	■	■	■	■	■
Can reboot host PC on disconnect	■	■	■	■	■	■	■	■
Call log	■	■	■	■	■	■	■	■
Password-protected callback	N/A ^②	■	■	■	■	■	■	□
Can disable host/keyboard	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	□ □	■ ■
Can disable mouse/screen	■ ■	□ ■	□ ■	■ ■	■ ■	□ ■	□ ■	■ ■
Access restrictions:								
By drive	□	□	□	■	■	■	□	□
By directory	□	□	□	■	■	□	□	□
By file	□	□	■	□	□	□	□	■
Environment								
Chat facility	■	■	■	■	■	■	■	■
Remote clipboard	□	■	□	□	□	□	□	■
DDE support	□	■	□	□	□	□	□	□
Scripting language	□	□	■	■	■	■	■	□
Prints at remote and host	■	□	■	■	■	■	■	□
Video								
Sends graphics changes only	■	■	■	■	■	■	■	■
Host can view remote screen	□	□	□	□	□	■	□	□
Screen caching	□	■	■	■	■	■	■	■
Maximum screen resolution supported	640 x 480	1,280 x 1,024	800 x 600	800 x 600	1,280 x 1,024	800 x 600	1,280 x 1,024	1,204 x 1,280
Maximum color depth supported	16	256	16	16	256	16	256	65,000
Remote can scroll to all parts of higher-resolution host screen	N/A ^③	■	N/A ^③	■	■	■	■	■

N/A^①—Not applicable: The operating system does not support this feature N/A^②—Not applicable: The product does not have this feature N/A^③—Not applicable: The product scales host display

software lets you copy newer files from host to remote directories or vice versa.

Drive mappings are stored in a Serve-Up file, which the administrator names when he or she creates a user's profile. The administrator can also create a "command" file associated with each user. The command file contains keystrokes that are simulated when the user logs in, providing a simple macro-playback facility. The user profile also lets the administrator specify basic file-access limitations (*read-only*, *write-only*, both, or neither), but the remote software enforces these privileges only within its file-transfer utility.

ADDITIONAL FEATURES

All the features you'd expect are present in ReachOut: phone book, connection log files, terminal-connect mode, chat mode with pager, and master passwords. The host software can be set to reboot the system immediately upon disconnect, after 5 minutes, or not at all.

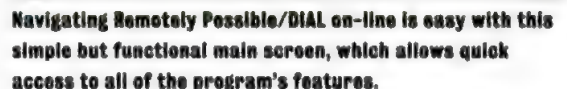
In spite of some minor bugs and the lack of strict security, ReachOut Remote Control merits serious consideration from just about any potential user.

- **Remotely Possible/DIAL**

In the \$199 Remotely Possible/DIAL, Version 4.0, Avalan Technology puts the "less is more" adage to good use, imbuing the package with an elegant simplicity that's hard to match. Furthermore, Remotely Possible turned in an adequate performance on most of our tests and offers a decent though fairly limited set of features. Solid though not stunning, Remotely Possible is the product of choice for users who prefer ease of use and a basic design above all else. The package comes in Windows and LAN versions.

Still, *Remotely Possible* lacks a few features found in some of the other programs we tested, most notably drive mapping. It also offers neither on-line help nor a lucid, well-designed manual.

Remotely Possible offers quick, one-disk installation. There's one installation utility for both the host and the remote (called



Remotely Possible lacks a DOS front end, but you can install a TSR that pro-

N/A —Not applicable. The product reconciles screens of over 640 x 480 pixels.

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computing
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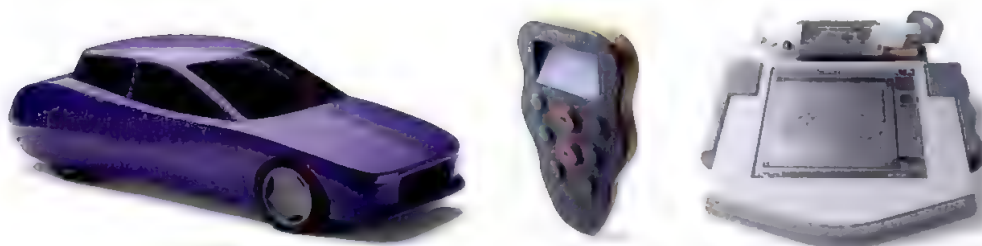
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► SUMMARY OF FEATURES

 								
Products listed in alphabetical order ■ = YES □ = NO	Carbon Copy for DOS	Carbon Copy for Windows	Close-Up	CoSession for DOS	CoSession for Windows	Norton pcAnywhere for DOS	Norton pcAnywhere for Windows	PolyPM/2
Modem								
Number of modems supported	120	162	690	154	164	160	170	75
Supports high-speed modems	□	■	■	■	■	■	■	■
Replaces Windows communications driver	N/A ¹	□	□	□	□	□	□	N/A ¹
Throughput range (bits per second)	300-38,400	300-115,200	300-115,200	300-115,200	300-256,000	300-115,200	300-115,200	9,600-38,400
Reports connect speed	□	□	■	■	■	■	■	■
Can utilize 16550A UART chip	□	■	■	■	■	■	■	■
Network modem support	□	■	□	■	□	■	■	■ (via free gateways)
Input								
Supports DOS mouse use on remote	□	□	■	■	■	□	□	■
Supports Windows mouse use on remote	□	■	■	■	■	■	■	■
Relays audio signals (beeps)	□	■	■	■	■	■	■	□
Host usage log available on-line	□	■	■	□	□	■	■	■
Remote usage log available on-line	□	■	■	■	■	■	■	■
Host notified of remote's call	■	□	■	■	■	■	■	■
Built-in virus protection	□	□	■	□	□	□	□	□
Text editor	□	□	□	□	□	■	■	□
Terminal Emulations								
Terminal emulators supported	ANSI, TTY, VT100	ANSI, TTY, VT100	TTY	VT102, TTY, VT100	None	ANSI, IBM 3101, VT100, WYSE 50	ANSI, IBM 3101, VT100, WYSE 50	None
Package allows connection with BBSs, on-line services, or mainframes	■	■	■	■	□	■	■	■
Support and Documentation								
Unlimited technical support	■	■	■	■	■	□	□	■
User manual	■	■	■	■	■	■	■	■
On-line help	■	■	■	□	■	■	■	■
LAN version available	■	■	■	■	□	■	■	■
Network support:								
IPX	■	■	■	■	N/A ²	■	■	□
NetBIOS	□	■	■	■	N/A ²	■	■	■
NetBEUI	□	■	■	□	N/A ²	■	■	■
TCP/IP	□	□	□	■	N/A ²	□	□	□
VINES	□	■	□	□	N/A ²	■	■	□

N/A¹—Not applicable. The operating system does not support this feature. N/A²—Not applicable. The product does not have this feature.

vides full-screen DOS support. Without the TSR, you can run DOS only in a window. Several features, including the chat and file-transfer utilities, are not available in full-screen DOS mode.

Remotely Possible makes minimal changes to your system setup files, and it modifies your AUTOEXEC.BAT file automatically. Unlike several of the other packages, Remotely Possible adds a DLL to your SYSTEM.INI file, instead of replacing the standard Windows driver. An uninstall feature removes all files, except any you created, and restores the original SYSTEM.INI and WIN.INI files.

The package supports all Windows

video resolutions and up to 16.7 million colors. It offsets the problem of clipping when the host and remote have mismatched resolutions by simply letting you resize the host window. You can also scroll to see more of the host screen.

The package's interface is refreshingly uncluttered; several large buttons in the middle of the screen facilitate navigation. These allow you to access all features, such as the chat and file-transfer utilities, with ease. The file-transfer utility lets you use drag-and-drop to copy single or multiple files between host and remote machines.

Limited directory synchronization lets you copy new files and new versions of

files in one operation. During file transfer, a dialog box displays vital statistics, including the size of the file, the average speed of the transmission, and the time remaining in the transfer. Remotely Possible doesn't support file-transfer protocols other than its own.

KEEPING WATCH

Security can be maintained in several ways. You can restrict (via passwords) on-line remote access to the address or password databases, and define access to certain modes, such as remote or file-transfer. However, security is not as granular as it is in other packages. For exam-

ENDS

ReachOut Remote Control	Remotely Possible/DIAL	Takeover
180 ☒ ☐ 1,200-115,200 ☒ ☒ ☒	160 ☒ ☐ 9,600-230,000 ☒ ☒ ☐	200 ☒ ☐ 576-115,200 ☒ ☒ ☐
☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒	☒ ☒ ☐ ☐ ☐ ☒ ☐ ☐	☒ ☐ ☐ ☒ ☒ ☐ ☐ ☒
ANSI-BBS, ASCII, VT100, VT52 ☒	TTY ☐	ANSI, D210, IBM 3101 TI, TTY, 940, WANG, WYSE-50, z-29 ☒
☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒	☒ ☒ ☐ ☒ ☒ ☒ ☒ ☒	☒ ☒ ☒ ☐ N/A ² N/A ² N/A ² N/A ² N/A ²

ple, you can't control read and write file access as you can in ReachOut or pcAnywhere, but you can limit a user to sending or receiving files. You can also disable the host keyboard, mouse, or screen. You can print at either the host or remote machines.

Remotely Possible supports Novell/ IPX and NetBIOS networks including Microsoft Windows for Workgroups, LAN Manager, LANtastic, Pathworks, and VINES. The next version of **Remotely Possible**, which should be out by the time you read this, will include TCP/IP support.

Remotely Possible's minimal use of hard disk space and well-designed inter-

▶ FACT FILE

Remotely Possible/DIAL, Version 4.0

List price: \$199 **Requires:** On the host: 200KB RAM (30K TSR), 87K hard disk space; on the remote: 200K RAM, 87K hard disk space, Windows 3.x. **In short:** Avalan Technology's Remotely Possible/DIAL takes a no-frills approach to remote computing. It offers the basics, including file transfer, chat utilities, and password security, but you'll have to do without some advanced features. The tradeoff is the package's ease of use: Installation, setup, and operation are a breeze. Remotely Possible's coup de grace is its support of 16 million colors.

Avalan Technology Inc., 116 Hopping Brook Park, PO
Box 6888, Holliston, MA 01746; 800-441-2281, 508-
429-6482 fax, 508-429-3179

SHIFTABILITY TO TASK

	Power	Ease
Setup and configuration	FAIR	GOOD
Remote control	GOOD	GOOD
Remote access	FAIR	FAIR
Security	FAIR	FAIR

505 on reader service card

face make for a no-frills approach to remote computing. These strengths, however, are offset by a modest feature set and minimal security and help. The trade-offs may be more than security-conscious power users are willing to make.

SoftKlone Distributing Corp.

- **Takeover, Version 2.1**

BY BEN Z. GOTTESMAN

Time is running out for SoftKlone Distributing Corp.'s \$199 Takeover. Version 1.0 received an Editors' Choice award in our 1990 roundup of remote-control software programs. In our 1992 roundup, we noted that the latest incarnation, Takeover Lite 2.0, was starting to show its age, as it was unable to run Windows on a remote connection. Two years later, the program has barely progressed. Version 2.1 adds only bug fixes and minor enhancements, including expanded support for high-speed modems.

BEARING UP

Takeover is the only product in our roundup besides Carbon Copy for DOS designed only for DOS remote control. With the other reviewed programs, you

VB Power



ISBN: 1-56276-073-4
Price: \$34.95

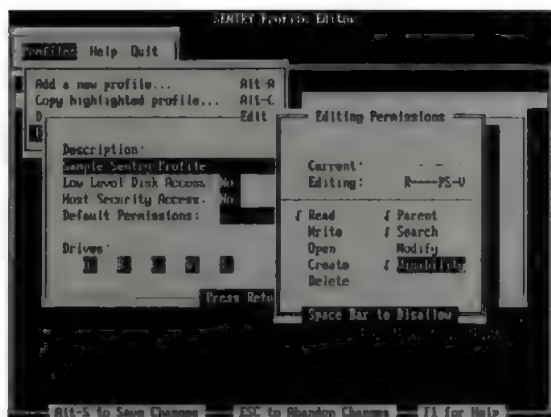
This innovative guide by
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Remote-Control Software



Takeover's Sentry utility gives the host the ability to assign specific drive, directory, and file access rights for each remote user.

can have the DOS TSR on the host, run the DOS remote, and still launch and execute Windows. With Takeover, it's virtually impossible to run Windows remotely. While the manual makes brief mention of Windows, the company claims no support, and we were unable to get reliable connections under Windows.

The Takeover package includes both

the host and remote modules (Takeover refers to the remote module as the *guest*). The program is designed to run only over modems or null-modem cable—there is no network version. SoftKlone does offer a version that supports shared modems.

Remote control of text-based DOS applications was fairly snappy, but the transmission of graphical screens, such as WordPerfect print previews or Quattro Pro spreadsheets in WYSIWYG mode, was intolerably sluggish, even when we used 14.4-bps modems.

Takeover finished dead last on our test involving the transfer of uncompressed files. In addition, we had to use different settings for optimal transmission speeds when sending from host to remote versus sending in the opposite direction.

Takeover does not possess a full-blown file manager, unlike many of the other products we looked at. This makes

the selection of files for transmission somewhat difficult. Also, there is no way to shell back to DOS temporarily on the remote side in order to perform quick actions such as creating directories or modifying a file you plan to transmit.

As we noted in our 1992 review of Takeover, there is no indication on the host that a remote user has logged on, nor

Takeover's Sentry feature allows users to specify several security measures.

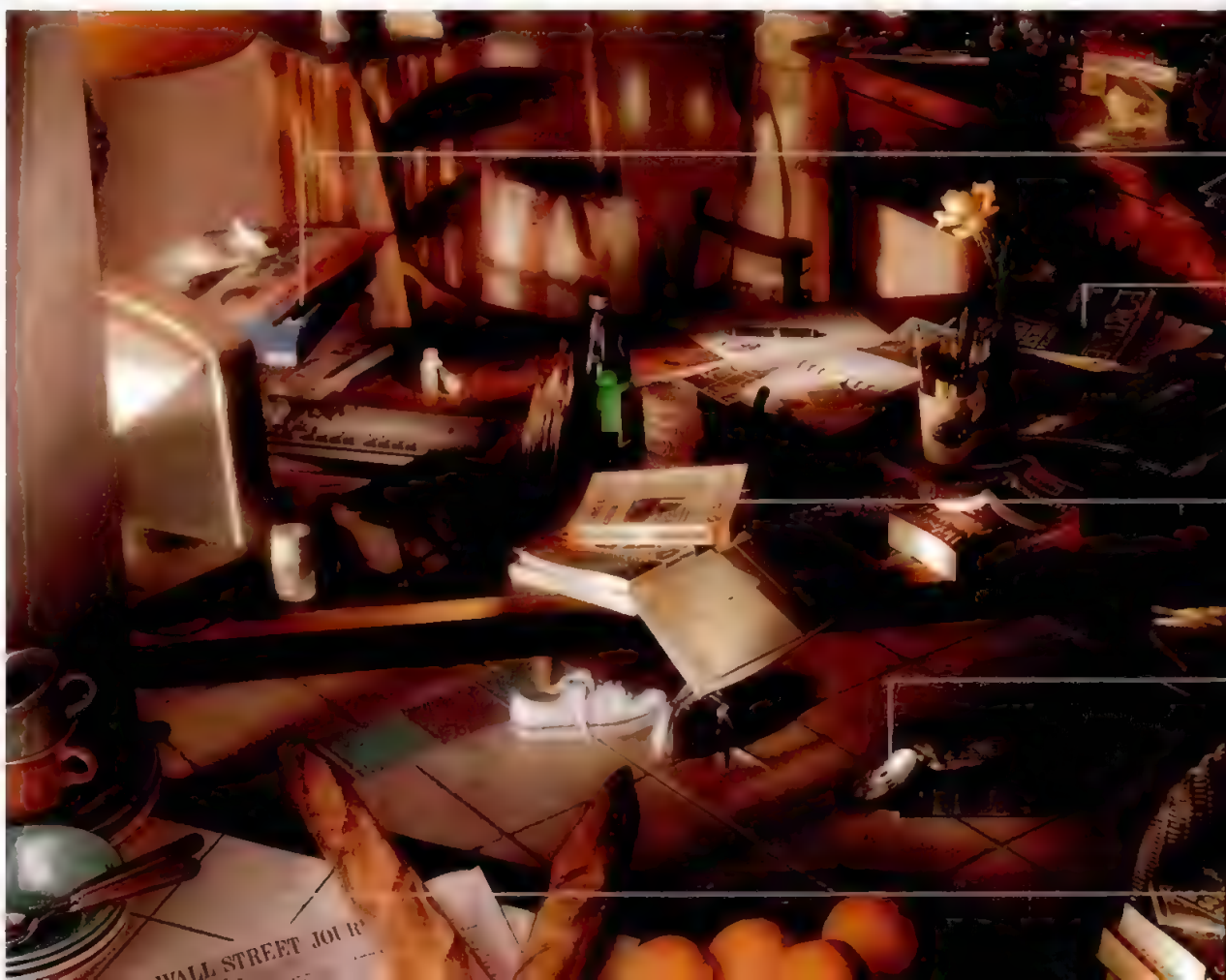
is there any indication that the user is performing a foreground file transmission. This can create a great deal of confusion between the two systems.

INTERFACING

The Takeover interface is fairly easy to use if somewhat nonstandard. Top-level



At home or work, you get instant access to six CD-ROMs with either the two or four speed model. And they'll both marry well to a network.



SOFTWARE
Remote-Control Software

menus are accessed by pressing the first letter of the menu name, Esc and the letter, or by using the mouse. Shortcuts are accessed with the Alt key rather than the Ctrl key. On-line help is minimal and often omits critical information. For example, to set up a callback, the host must indicate a callback number and the remote must place an *H* before the phone number. Not only should the remote step be unnecessary, but there is no indication of the need for the *H* in the help. We also experienced numerous lockups with Takeover, especially if the modem connection was not terminated from the remote side.

Takeover does ship with SoftKlone's Mirror III, a powerful DOS-based communications program. Mirror III contains a wide variety of terminal emulations and file-transfer protocols. Mirror III and the Takeover Guest share a common dialing directory, allowing the user a single interface for DOS-based communications. SoftKlone has also added Takeover-specific commands to Mirror III's PRISM (programmable integrated

▶ FACT FILE

Takeover, Version 2.1

List price: \$199 **Requires:** On the host: 73K RAM (48K extended memory), 500K hard disk space, DOS 3.1 or later, on the remote: 435K RAM, 1MB hard disk space, DOS 3.1 or later **In short:** A former Editors' Choice winner, Takeover has not been able to keep up with the pack. This DOS-only package performs dismally, and its feature set is only mediocre. We don't recommend using the program for graphics (including Windows). But with help from its bundled sister product, Mirror III, the program boasts strong security and scripting capabilities.

SoftKlone Distributing Corp., 327 Office Plaza Dr., #100, Tallahassee, FL 32301-2776; 904-878-8564; fax: 904-877-9763

SUSTAINABILITY TO TASK		
	Power	Ease
Setup and configuration	FAIR	FAIR
Remote control	POOR	FAIR
Remote access	FAIR	POOR
Security	EXCELLENT	GOOD

506 on reader service card

scripts for Mirror) programming language to extend Takeover's power. Users can use PRISM to automate remote-control tasks. For example, one sample PRISM script automatically synchronizes directories between the remote and the host machines. Users can also automate Takeover by specifying a batch file to run each time a connection is made with a specific remote user.

SECURITY ISSUES

Takeover's Sentry application provides very powerful security features. With Sentry, the host can specify the file-management tasks the remote user can perform—such things as read, write, open, create, and delete—on specific directories and files.

If you work entirely in text-based DOS applications and have a need to automate your remote-control procedures or have a need for strong security, Takeover is worth a look. For anything except these specific situations, however, this remote-control product is difficult to recommend. □

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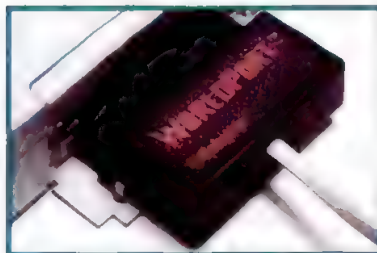


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REMOTE-NODE SERVERS

Remote-node access means better productivity for remote users who need access to office LAN resources and a consolidated package for network managers.



Extend Your Reach

It is generally satisfying enough that advances in PC-related technology let us do some old job in a better, faster way or make it possible to do something new that is really helpful. But sometimes the payoffs go a lot farther than even that. Such is the case with remote-node access.

Technology, productivity, practicality—and even legality, of late—all merge with remote-access products. Giving employees remote access to the network improves productivity and reduces costs in many ways. Serendipitously, it also makes it easier for businesses to conform to mandates in the new federal Clean Air Act, the federal Family and Medical Leave Act, and related state and local regulations (see “It’s the Law!”).

Remote-node access means that by using one of the products in this roundup, a person working on a PC at home or who is traveling with a laptop can connect and become an actual *node* on the network and access drives and any other resources to which he has been assigned rights. It is different from remote control in several key ways. (See the sidebar “Managing Your Nomads” and the roundup of remote-control products, “How to Be in Two Places at Once” in this issue.) Many businesses use both, depending on the situation.

In this article, we review 10 products that make remote PCs

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By Frank J. Derfler, Jr.

a part of the network. We look at server products that provide simultaneous access for four or more callers, and support NetWare's IPX protocol over Ethernet.

We tested Digital Communications Associates' (DCA) Remote LAN Node (RLN) Turnkey Server; IBM LAN Distance, Version 1.1; the Microcom LANExpress; Multi-Tech Systems' MultiCom-RNGateway, Model MA8ER; NEC America's Dr. BonD-S; Novell's NetWare Connect; Shiva Corp.'s LanRover/E 2.1 for NetWare; Stampede Technologies's Remote Office, Version 1.2; Telebit Corp.'s NetBlazer PN4; and 3Com Corp.'s AccessBuilder. U.S. Robotics, a well-known name in the modem industry, didn't have a four-port product for our review, but one will soon be on the market. Cayman Systems, CommVision, Gateway Communications, and Livingston Enterprises have products that would have met our review criteria, but they declined to participate for various reasons.

Remote access has become very popular, and this is a strong field of maturing products. But because they combine networking and communications, melding modems with a LAN, you still face some potentially imposing technical questions as you choose between them.

We considered the hardware configuration and the server and client software portions of each. We looked at ease of installation and configuration, manageability,

■ It's the Law

By Frank J. Derfler, Jr.

Studies show that employees produce more and are happier when they can telecommute. Companies can reduce costs for everything from office space to utilities through telecommuting, so it's good business. Apparently Congress thinks so, too.

The Clean Air Act of 1990 has provisions that kicked in during late 1993 that surprised many senior managers. The Act directs that if you have more than 100 employees and are in certain metropolitan areas designated by the Environmental Protection Agency, you have until November 15, 1994, to design a plan to reduce travel

to the worksite during peak hours by 25 percent. Your environmental agencies should have already told you if you have to take actions, but this affects companies across the country. (Also see "Don't Pollute, Telecommute," Trends, *PC Magazine*, February 22, 1994.)

Similarly, the Family and Medical Leave Act of 1993 provides for up to 12 weeks of unpaid leave each year for specific family and medical reasons. Because it often would benefit both the employer and employee to get some work done during that time, the Act provides for options such as telecommuting. □

dial-in (client) support, and dial-out/LAN-to-LAN support, all against performance and pricing. Our Editors' Choice, Shiva's LanRover/E, combines ease of use with good performance and price.

In general, we found that more flexibility, in terms of the types of network and client PC OSs these products support, also increases the complexity of installing and managing them. Also note that while the products in this roundup have four or more serial-port connections, other products are available with fewer ports (see

"Remote-Node Lite").

Some installations might not need separate remote-access products. Microsoft Windows NT, for example, has a built-in utility called Remote Access Service (RAS) that works in the same way as the products in this roundup (see "But I Don't Have NetWare").

WHAT PRICE ACCESS?

It takes some study to compare the costs of these products, because some include everything you need, some include soft-

HIGHLIGHTS

Remote-Node Servers

USERS NEED REMOTE ACCESS to their companies' networks. Business staffs are spread out geographically, people travel all the time, and new laws mandate that employers reduce commute situations.

TECHNOLOGY IS KEEPING UP—at least to a point (modem speeds remain the principal throughput bottleneck). Two approaches are available. Remote-node servers offer a more manageable, cost-effective alternative for large groups of users connecting remotely. Remote-control products (also reviewed in this issue) are very inexpen-

sive and work for individuals connecting directly to their desktop PC.

REMOTE-NODE SERVER PRODUCTS

have two parts—the server portion, which must support your network's transfer protocol (NetWare's IPX, for example), and the client portion, which runs on the remote client PC. Check each product here for support of your Windows, DOS, OS/2, and Macintosh remote users.

EASE OF USE is important. Administrators want a product that is easy to install and configure, like Shiva's Lan-

Rover/E, Stampede's Remote Office, Telebit's NetBlazer PN4, and 3Com's AccessBuilder. Remote users need a good user interface, like the one in Microcom's LANExpress, and a dial-out capability, as LanRover and NetWare Connect have.

A GOOD REMOTE-ACCESS SERVER

should offer good reporting and security features. In our testing, IBM's LAN Distance offered the most extensive security features. Microcom's LANExpress and DCA's Remote LAN Node Turnkey Server include their own management programs.

ware with the serial-port hardware, and a few consist of software only.

Shiva's LanRover/E is a good value at its price of \$2,899 for four ports (you supply the modems). The Microcom LANexpress is a complete remote turnkey solution at \$4,999; four 28.8-Kbps modems are included. IBM LAN Distance seems like a bargain at \$595 for eight-port software, but you must add serial-port hardware and establish an OS/2 server. Similarly, when you add the necessary hardware to Novell's \$2,195 eight-port NetWare Connect software, it jumps to the high end of the cost scale even if you discount the necessary NetWare server.

The bottom line: Establishing a remote-control server will probably cost you between \$700 and \$1,000 per port for the first two to four ports. And most of these vendors offer complete lines of remote-access products. The benefits in productivity gains for users and businesses, however you gauge it, make remote-node access a good investment.

CONTROL VS. CONNECTION

Network remote-access products break into three categories: remote control, remote node, and bulletin board service (BBS). Remote-control products allow the caller on a remote PC to run programs on a networked PC. This approach is appropriate for people who don't have powerful PCs at home or on the road.

BBS programs are software that answer a call and present a limited menu of options. They are a part of all major communications packages. BBSs are easy to use and maintain and provide high security. Their best uses are in file transfer and electronic messaging.

The remote-node access products here provide the calling PC with an extension of the network through the modem, across the telephone line. The person using the calling PC has a full selection of



● Shiva LanRover/E 2.1 for NetWare

Shiva knows remote access. The LanRover/E 2.1 for NetWare carries all the hallmarks you would expect from a company with that experience. A superior turnkey remote-access solution that is remarkably easy to install, LanRover/E has a well-

executed Windows interface and was one of our performance leaders. Shiva Corp. pulls dial-in remote access, modem pooling, and network administrator concerns together to form a compact, clean package that works well for remote user and network manager alike. All you need to supply are the modems, and while other products include the modems as part of a bundled solution, this solution is cost effective since any generic modem will do.

The LanRover/E supports dial-in remote-node access, dial-out modem pooling, and even dial-up routing (though we didn't test that for this article), all in one box. Moreover, it works with either Ethernet or Token-Ring, and supports the IPX, TCP/IP, NetBEUI, and Logical Link Control (LLC) protocols.

With LanRover/E, network managers can set up individual users, groups, and passwords either with Shiva's utility or by importing users and security data directly from the

NetWare Bindery. Thus, administrators need to maintain only one user list, and they can provide for various access privileges and restrictions for security.

One of the LanRover/E's only drawbacks is that you need to buy a different box for AppleTalk support if you have any remote Macintosh users. Otherwise, this is a well-priced, mature package that will be a good choice for many networks.

We give an honorable mention to Microcom LANexpress. With its four included Microcom 28.8-Kbps internal modems—the kind of speed you want for this kind of access—LANexpress is a complete turnkey solution that is loaded with features. It includes dial-in and dial-out functions, as well as remote control for an unlimited number of users through its bundled software, Carbon Copy. An excellent interface makes installation and configuration easy, and the included client software is first-rate as well. LANexpress also has a full complement of security functions.

disk drive letters, printers, and other network resources to choose from. The remote caller must be careful in taking actions, though, because the modem link operates at only a few tens of kilobits per second—not the tens of megabits per second of an actual LAN connection.

Remote-node products are aimed at client/server applications as diverse as cus-

tomized ordering and inventory programs, Lotus Notes, and electronic mail programs. They work best when the calling PC has enough RAM and CPU power to run applications while handling modem communications in the background. Typically, these are the most up-to-date laptop and desktop PCs. Also, because remote-node devices cram a lot of data through the telephone line, they must have the fastest modems available on both ends.

DOs AND DON'Ts

Modem connections operate at about 1 percent of the signaling speed of network connections. Thus, although a disk drive letter or a printer name looks the same on a PC connected over the LAN or through

Our Contributors: FRANK J. DERFLER, JR., is senior networking editor of *PC Magazine*. STEVE RIGNEY is a network consultant based in Destin, Florida, and a frequent contributor to *PC Magazine*. GARRY FRENKEL examines emerging technology for a Fortune 100 firm. J.C. LOVE is the manager of information systems for UCLA Facilities Management. VISHY NARAYAN specializes in high-speed networking for a large consulting firm. SHAWN KAFIPOUR is a senior project leader at ZD Labs. GAIL SHAFFER was the associate editor in charge of this story, and ROBERT P. LIPSCHUTZ was the project leader.

remote access, it doesn't work the same. In our tests, we saw an average throughput for an .EXE file of about 16 Kbps (see the Performance Tests). At that rate, for example, it would take about 25 minutes to load Microsoft Word for Windows from the file server. Obviously you'll want to have applications already loaded on remote PCs wherever possible.

You must carefully configure the calling PC so that all of the large files it needs are also on its own hard drive. You want to push and pull *only* necessary files through the modem. This means that log-on programs, utilities, virus protection programs, and anything else that you might normally pull from the file server should be on the calling PC.

Remote-node products complicate the job of the network manager. Calling PCs might need careful customization to conserve disk space. It also becomes more difficult to update software when network utilities are spread across a large group of traveling machines.

MATTERS OF PROTOCOL

Because remote-node access devices extend the network, they are sensitive to the networking *protocols* used on the net-

work. Essentially, protocols are agreements about how programs package and exchange data. The two most important protocols in networking are TCP/IP (Transmission Control Protocol/Internet Protocol), used on the Internet and with Unix-based computers, and the IPX (Internet Packet Exchange) protocol, used in NetWare.

*Because the modem
is slower than the
LAN, you want to pull
and push only
necessary files through.*

Apple's AppleTalk protocol is also found in many places. NetBEUI, an extension of the older NetBIOS protocol, is important to people who use OSs such as Microsoft Windows for Workgroups, Artisoft's LANtastic, and Performance Technology's POWERLan. Networks that run Microsoft Windows NT and NT Advanced Server can use IPX, TCP/IP, or NetBEUI.

takes. We give credit for Windows-based utilities and for products that generate user lists from the NetWare Bindery (managers have only one user list to maintain). We also note differences between hardware/software turnkey solutions and software-only solutions. Our ratings take into account NetWare frame types supported, ease and flexibility of user and port configuration, architecture, and integration with the Bindery. Products that receive the highest ratings have quick and easy installation and configuration options.

For **management** capabilities, we rate features such as packet and user use statistics, port status, trace and audit logs, and flexibility in how and where you must conduct management functions. We also consider whether the product is SNMP manageable and the software is upgradable. The best products include in-band management utilities that let you manage from a LAN-attached workstation. We give high ratings to remote-node server packages that provide robust security, reporting, and tracking of management capabilities.

Most of the products here offer multi-protocol support. They work well with NetWare's IPX and are relatively simple to set up. If you need support for a specific protocol, check the Summary of Features.

A few of these products make it possible to use the networked modems and telephone lines for outgoing calls. This is called dial-out. LANexpress, NetWare Connect, and LanRover/E, for example, come with this ability under IPX and you can add it to RNgateway, NetBlazer, and Remote Office. The NetBlazer and the Dr. BonD-S can dial out in networks running IP. Network dial-out is found in all modern communications software. Its principal value is in reducing the number of telephone lines you have to run to the desktops in your organization.

OPENING THE PORTALS

The phrase *turnkey solution* implies that a product is so complete and easy to install, that all you need to do is "turn the key" to use it. Sometimes it simply means you get all the pieces in one package—not that they all work together so easily. Most of the products we looked at are billed as standalone turnkey network devices.

Suitability to Task: Remote-Node Servers

It's simply a given these days. More and more, people are working away from the office, either at home or on the road. Portable PCs are powerful, lightweight, and affordable. They make working away from the office easier. But with the office network now central to productivity, users need to connect to it remotely to access files and other resources. To accommodate the changing needs of users, network administrators must face adding yet another, albeit important, device to their busy LANs: a remote-node server. A good remote-node server should not introduce complexity, but it should install easily and do its job well, while integrating smoothly with other network devices.

Under **installation and configuration**, we consider the product's install utility, the time it takes to install, its network installation, as well as the complexity of its configuration and the time that

Dial-in support is, of course, critical to the success or failure of a remote-node server. We look at dial-in capabilities from the remote user's point of view. Our considerations include performance, supported

SUITABILITY TO TASK	
Installation and configuration	POOR
Management	FAIR
Dial-in	GOOD
Dial-out/ LAN-to-LAN	EXCELLENT

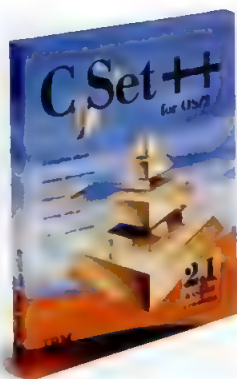
operating systems for the client software, user interface, phone books available, and callback facilities. To receive a high rating here, a package first and foremost must offer an easy-to-use interface and fast performance. High scorers also provide simple client-software installation and support multiple operating systems.

In the **dial-out/LAN-to-LAN** category, we rate the product from the aspect of the person on the local office network who is calling out to the remote user or to a remote service. Considerations include DOS and Windows support and multiple protocol support. We also noted the facilities available to the administrator for setting up ports as dial-out and dial-in. To receive a high rating in this category the package should include support for both NASI (NetWare Asynchronous Interface) and interrupt 14h.

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Only LAN Distance, NetWare Connect, and Remote Office require you to add a PC and stir. Others require modems.

The so-called turnkey products can have their own problems. We had a hard time talking to the RLN Turnkey, Dr. BonD-S required trial-and-error configuration, and Telebit's remote caller software for the NetBlazer was difficult to install.

In contrast, Shiva's LanRover/E and Stampede's Remote Office were both very easy to install, even though they are very different types of product. Shiva ships a box that looks like a modem with a LAN port attached. After you plug in the cables, you're practically ready to connect. Stampede's entry ships with software and a multiport serial board that you must install in a PC. But Stampede has done a good job on the installation software.

SECURED, MANAGED, READY TO GO

Many network managers quake when they think about opening their network to outside access. They fear hackers, viruses, and other threats. All of these products offer password protection and most have features such as call-back (the modem can call a remote caller back

from an internal preprogrammed list of phone numbers).

LanRover/E and NetWare Connect integrate with NetWare 3.x's Bindery of names and privileges, so the manager has only one list to keep straight. The biggest security threat comes from sloppy protection of passwords rather than from technical trickery. LAN Distance goes the farthest in security, allowing for long password phrases and even limiting access according to a physical identification in the calling unit.

As networks grow, managers are concerned about managing increasing resources and gathering reports for troubleshooting and budgeting. Such products as RLN Turnkey, LAN Distance, LAN-express, Dr. BonD-S, Lan Rover/E, NetBlazer, and AccessBuilder offer extensive control through the Simple Network Management Protocol (SNMP). Multi-Tech has its own management program. NetWare Connect is managed through NetWare.

Remote-node products offer a far-reaching, affordable, yet vulnerable network connection. Invest in a product that makes connections as easy as possible for your users—and gives you a few good tools as well. In remote access, the people

in your organization hang at the end of a thread that has to work invisibly, but reliably. Here's a look at your options.

Digital Communications Associates Inc.

Remote LAN Node Turnkey Server

BY STEVE RIGNEY

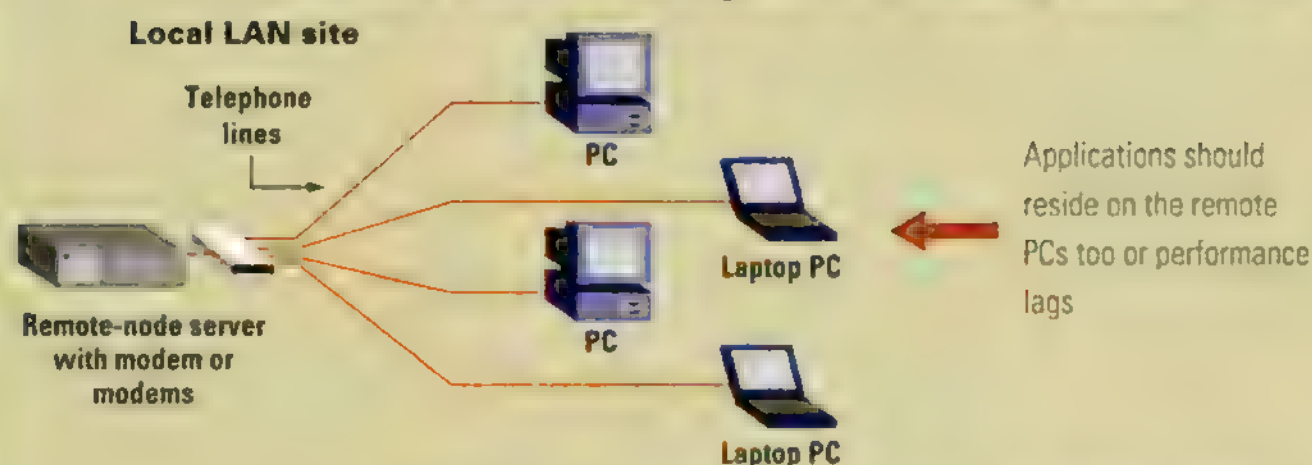
The Remote LAN Node (RLN) Turnkey Server offers a lot for its \$3,845 price—at the high end in this field. The four-port device from Digital Communications Associates (DCA) combines a PC, multiport I/O card, and network adapter with DCA's RLN, Version 2.01, software to provide a turnkey remote solution for Windows- and DOS-based clients.

Unlike most remote-access servers in this roundup, RLN Turnkey offers a domain naming system, similar to the one used by Microsoft Windows NT, to keep track of users, groups, and network resources. Installation, however, is not simple, and the product has no dial-out capability.

The RLN Turnkey remote-access server provides an SNMP agent and management software, centralized management and configuration, strong security, and support for multiple network proto-

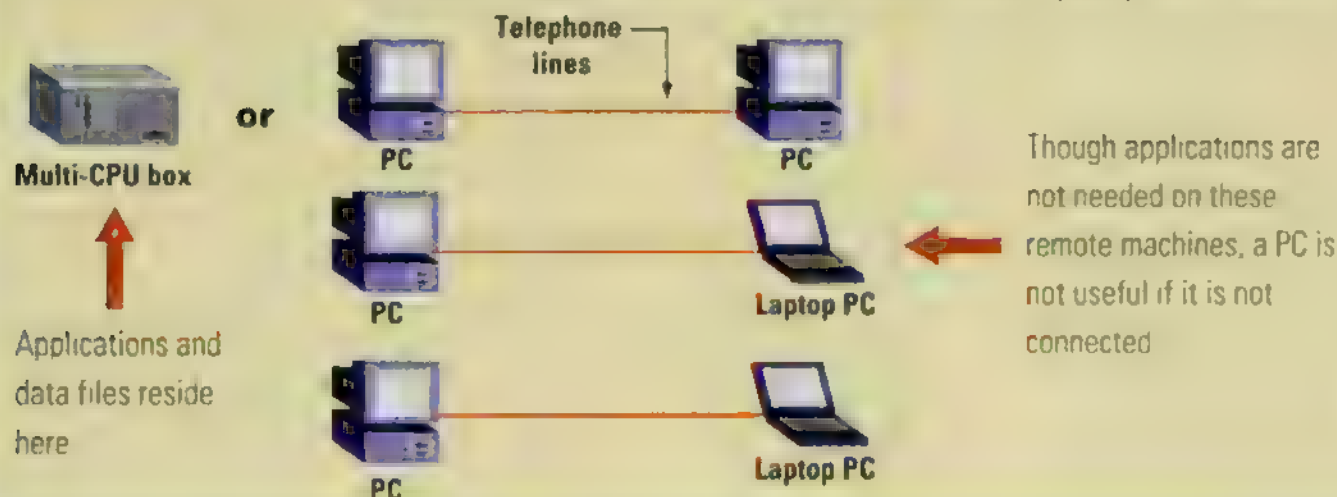
Two Approaches to Access

Remote Node one single-CPU—based server for several remote PCs



- Harder to maintain applications.
- Easier to manage one remote server.
- Slower performance unless remote system also holds applications.
- Good for Windows applications, which tend to be graphical.
- Better for Windows-equipped remote PCs.
- Better for client/server management.

Remote Control one local CPU (PC) for each remote PC



- Easier to maintain centrally located applications.
- Harder to manage many CPUs.
- Suitable for older systems: Remote PCs do not require much processing power or RAM.
- Good for most DOS applications.
- Better for managing network remotely.

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Managing Your Nomads

By Robert P. Lipschutz

People want access to their office PCs and networks at any time, from any place. For the obliging network manager, this means giving users access to network resources from home and from the road. But how do you manage this increasingly critical inlet into your network? In this fast-growing market, vendors compete and cooperate to make remote access more manageable, flexible, and scalable.

REMOTE CONTROL

Remote control answers people's need to access their desktop business computers from home or from the road. These same users seem eventually to want remote access to network resources as well. Fortunately, remote control extends access nicely to network resources.

But this approach toward expanding traditional remote control through integrating network access carries two problems: manageability and security. Management is a problem for both the network administrator and the user. If, for example, you are on the road or at home and your desktop PC gets turned off somehow or it crashes, you have little recourse. Risks to security can have broader ramifications. Just one naive user forgetting to password-protect a line can open up a network to unauthorized access from outside.

One approach to solving this problem is to stack multiple PCs in one room and to configure each as a remote-control host. This way, network managers can control critical resources while remote users can continue to access all files and applications on the network.

Some vendors furnish a more elegant solution. The J&L Information Systems Chatterbox/NRS and Cubix Corp. ERS/FT, for example, are dorm refrigerator-size chassis that house more than a dozen independent processor cards. Each processor sup-

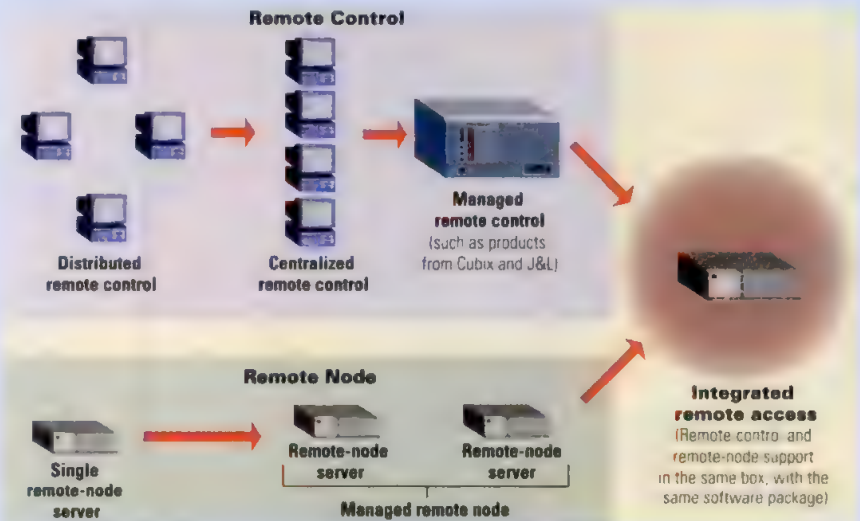
ports a remote-control session, and the entire box or even multiple boxes can be managed from one console. These boxes cost \$10,000 to \$20,000 and up, fully loaded, but you may save money in the long run because your management costs are lower.

Citrix Systems takes a different approach with its WinView for Networks. It uses the multitasking features

be added to the domain, which extends across multiple remote servers. Shiva and Microcom use SNMP-based management that scales up easily.

INTEGRATED REMOTE ACCESS

As your business's remote-access needs expand, you may need to offer both remote node and remote control. Previously, you would purchase two



of the OS/2 kernel to deliver multiple remote-control sessions on one processor. You can run Windows and DOS applications using this ingenious approach. Using WinView, ten remote-control sessions can be housed and managed in one computer.

REMOTE NODE

Remote-node vendors also have improved manageability and scalability. If your company keeps about 8 to 16 ports busy on your network, you can live with a single remote server. But if you grow beyond that, you will appreciate an integrated management architecture.

Digital Communications Associates (DCA), Microcom, and Shiva have architectures that help network administrators manage multiple remote-node servers. DCA groups remote-node servers into domains. Users can

separate products. Now, many vendors are marketing integrated remote-access solutions.

Novell's NetWare Connect offers remote-node sessions, but when coupled with a LAN-based remote-control package like Symantec's Norton pcAnywhere/LAN 1.0 (\$495), it provides for remote control and remote node using the same modems.

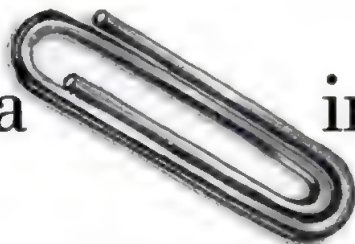
Microcom bundles its Carbon Copy remote-control software with its LAN-express remote-node product. Both Cubix and J&L have introduced product lines that integrate NetWare Connect into the multiprocessor chassis. DCA, with its Remote LAN Node Application, partners with Citrix to give you everything in one box. DCA is even promising intelligence—to help remote users decide which they need: remote control or remote node. □

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there's a



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there's



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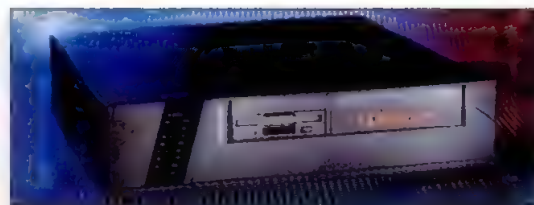
cols, including IPX, TCP/IP, NetBEUI, and NetBIOS. It also supports both Ethernet and Token-Ring connections using NetWare, Microsoft Windows NT, or Banyan's VINES.

RLN Turnkey's price per port is higher than that of some competing products, such as Shiva's LanRover/E for NetWare. As an alternative to the RLN Turnkey, DCA also offers a software-based version of RLN for \$2,250 for a four-port license, packaged with a multiport adapter and network card.

Two methods are available for installing and configuring the RLN Turnkey. You can attach a PC to the server and use a terminal emulator, or you can use the Windows-based RLN Manager

utility. We encountered problems with both. In order to communicate with the RLN Turnkey using RLN Manager, you must load a TCP/IP protocol stack that complies with Microsoft's WinSock on your Windows-based PC. DCA includes a single-user license for FTP Software's PC/TCP. But you can use any WinSock-compliant TCP/IP stack.

Installation presented two problems. Loading the TCP/IP drivers in combination with the ODI drivers was not intuitive, and the terminal-emulator program made changes to the net-



The DCA RLN turnkey server packs together a PC, multiport I/O card, and network adapter and includes 16 port LEDs.

Remote-Node Lite

By Steve Rigney

If you don't need the four or more dial-in ports provided by the products in this review but you still want remote-node access, you've got some other choices. Products with one or (typically) two ports provide many of the same features.

Some of the more popular products with one or two ports are Shiva's NetModem/E, Xylogics' MicroAnnex NCS, and U.S. Robotics' Shared Access LAN Modem and Com Server. They have lower prices, but beware: They can cost more if you expand your connection capabilities.

Prices range from \$995 (\$1,295 with a modem) for the dual-port NCS to \$1,995 for the dual-port Ethernet Com Server. They do not offer the same economy of scale as the higher port-density units; something important to remember if you think you'll need more capacity later.

But how's this for capability: The NetModem/E, Com Server (\$1,995, two Ethernet ports, one serial port) and Shared Access LAN Modem (\$1,995, two Ethernet ports, one serial port) both include an internal 28.8-Kbps modem. Several multiport solutions do not provide modems.

The Com Server even includes a

486 processor that allows you to control the access server remotely and simultaneously connect to the LAN as a remote-node client. Most other products only provide remote control by using a network remote-control software package.

All of these single- and dual-port remote-access servers provide dial-in remote-node capabilities for Windows and DOS clients. The NCS and NetModem/E also provide dial-in support for Macintosh clients. While all of these products work over NetWare's IPX protocol, some also allow you to dial in using NetBEUI and IP. You can also use the NetModem/E, LAN Modem, and NCS products as inexpensive LAN-to-LAN routers.

Security and management features are also similar to the multiport models. You can set up security based on user name and password, configure a call-back option, and set a time-out when a connection is not in use. You can also monitor port status and keep a log of dial-in users and how long they are connected. You can save this information in an audit log and use it to decide whether you need more remote-access ports.

Some of the products, such as the NCS, provide an SNMP agent and a management utility for monitoring

port and connection status and configuring multiple access servers from a central location.

Dial-out is another important feature. It will obviate the cost of pulling another phone line to every desktop and purchasing multiple modems. Most of these products allow you to dial out using any Windows communications software by redirecting your local COM port to the shared modem and any DOS-based package that supports interrupt 14h or NetWare Asynchronous Interface (NASI).

In addition to the turnkey solutions noted here, software-based remote-access servers such as DCA's RLN, Stampede's Remote Office, and IBM's LAN Distance can be configured for lower port counts. These solutions require a dedicated PC and take time for installation and configuration, but they offer greater expandability. However, they do not offer network dial-out through a shared modem without additional purchases.

Single- and dual-port remote-node access servers typically include many of the features and capabilities of servers with four or more ports and cost less to get up and running. Plan carefully, though. If your remote-access needs grow, you'll pay more. □

Remote-Node Servers

work startup, which resulted in errors at boot-up time. Once you connect to the RLN Turnkey, you can add users and groups, define ports and modems, and set up various security features.

The RLN Manager is a Windows-based SNMP utility that communicates with an SNMP agent in the RLN Turnkey. RLN Manager allows you to set up users, groups, and passwords, configure dial-back support, and monitor the

traffic on each port.

Like the IBM LAN Distance, the RLN Server can also assign logical MAC (media-access control) addresses to remote nodes for extra security and troubleshooting. With RLN Turnkey, not only do you have to know your user name and password, but unless you change the default configuration you must use the very same PC when you dial in remotely. This enhances security in case a name or

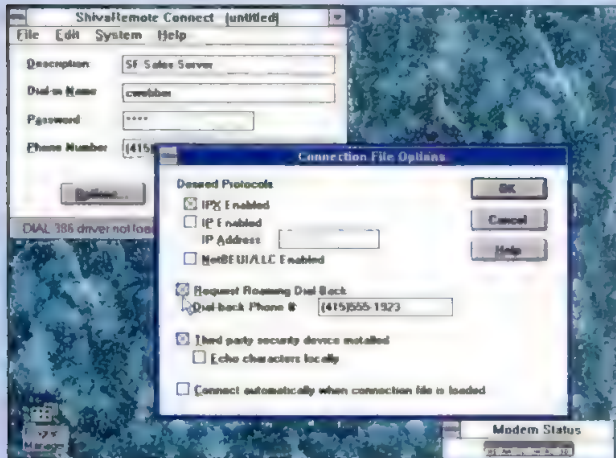
password is stolen.

The RLN Client Maker allows you to create customized RLN Client floppy disks, which is great if you have multiple client PCs. The RLN Client disks can include appropriate networking files and LAN-protocol and communications settings.

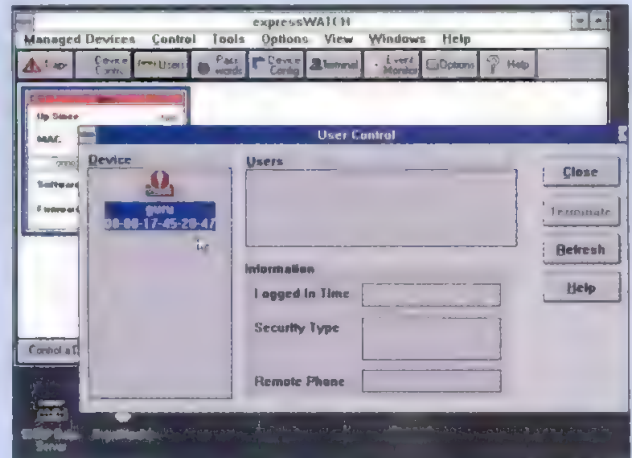
RLN's ability to run over multiple protocols and network operating systems coupled with good security features is appealing. But if you need dial-out features,

Putting on a Good Face

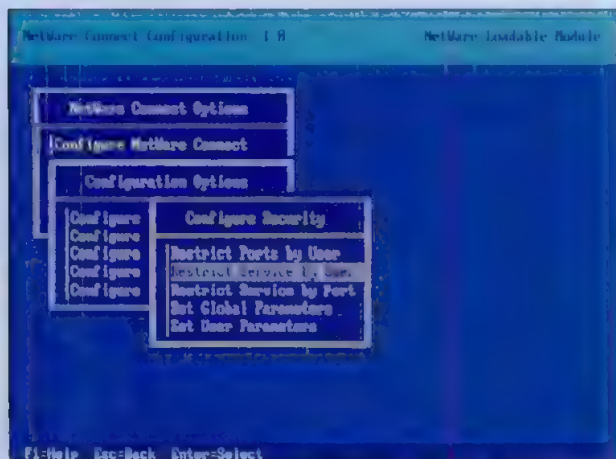
In a remote-node package, both the server and user portions need to be intuitive and easy to navigate. Here are a few examples of successful interfaces.



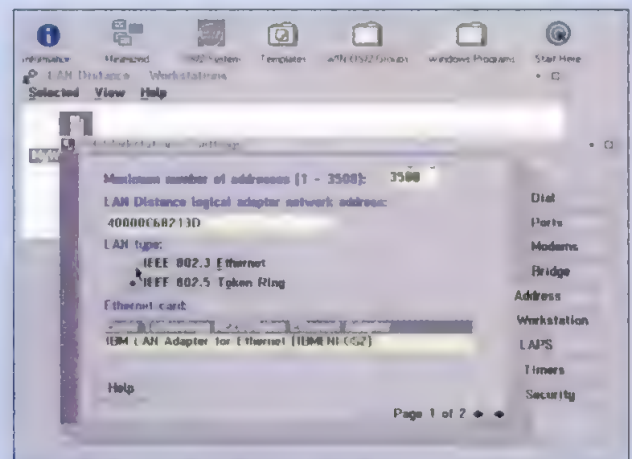
LanRover/E's Windows interface lets users and network managers jump into remote access without a lot of trouble.



The LANexpress utility, expressWATCH, makes excellent use of Windows in providing an interface that is easy to navigate.



NetWare Connect's menu-driven interface will be familiar to network managers who use NetWare. It is a tight integration.



IBM LAN Distance is the only product in the field to offers users the rich OS/2 graphical interface. IBM also offers strong security.



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What the Numbers Mean

With remote-node links over analog telephone lines, the modems you use will be the primary bottleneck. Although we used 14.4-Kbps modems for our performance testing, you will probably see improved performance if you use a higher-speed modem, such as 28.8-Kbps modems. (We'll review modems that are faster than 14.4 Kbps in an upcoming issue.)

In addition, file compression matters. We found the greatest differences between the products when we transferred moderately or highly compressible files. The LanRover/E 2.1 for NetWare and Remote Office, for example, did extremely well on the graphics and text file-transfer tests. But the Multi-ComRNGateway, Model MA8ER took about twice as long as the leaders when transferring files that were more than slightly compressible."

With noncompressible files, we found differences to be marginal. If you plan to send precompressed files, such as those created by PKZip or StuffIt Deluxe, all of these products will let you do so in about the same amount of time.

All of these packages use NetWare client software—and the IPX network protocol—to let you connect to remote NetWare servers. Older versions of client software used Novell's NETX driver to let you attach to servers. Novell's newer drivers, called Virtual Loadable Modules (VLMs), improve performance by using a technology called *packet burst* to send data. With NETX, the client PC must send an acknowledgement every time it receives a packet, a process

that can slow transmission over modem lines. With VLMs using packet burst, the server can send many packets at once, without waiting for an acknowledgement, thus improving transfer times over slow connection links.

Our testing confirmed that in most cases, using VLM client software with packet burst improves transfer times, especially for compressible files. (Note that the IBM LAN Distance Windows client supports VLMs but not with packet burst enabled—hence the slower timings.)

In our remote-node scenario, there are three principal ways to perform compression: with the modem, with vendor-provided software, or with third-party software. The modems in our test-bed automatically compressed data using the V.42bis compression scheme, although some of the reviewed packages, such as Remote Office, also give you the option of compressing files with client software. This option is especially useful if your modem does not compress data automatically.

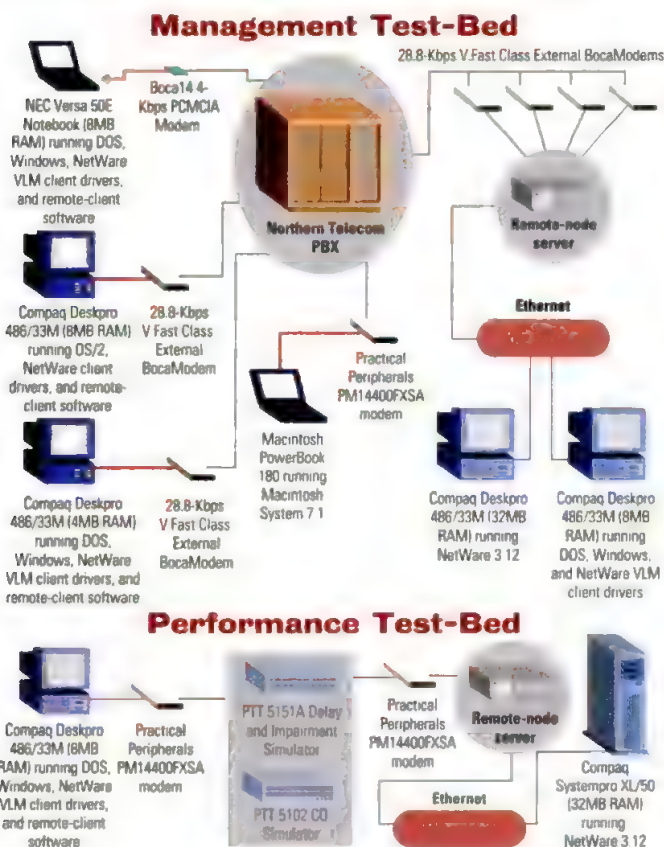
The *DTE (data terminal equipment) speed* is the speed at which your computer talks to your modem. If your modem compresses data on the fly, then you should set your DTE to a higher speed, such as 38.4 kilobits per second or 57.6 Kbps. We ran our tests at 57.6 Kbps for all except the IBM and Telebit products. Telebit's NetBlazer PN4 worked well at 57.6 Kbps under DOS, but under Microsoft Windows the system would hang unless we set the DTE at 19.2 Kbps (the default setting). With IBM LAN Distance, the OS/2 remote client would connect reliably only at 38.4 Kbps (the default setting) or slower.—*Analysis written by John Garriss*

How We Tested

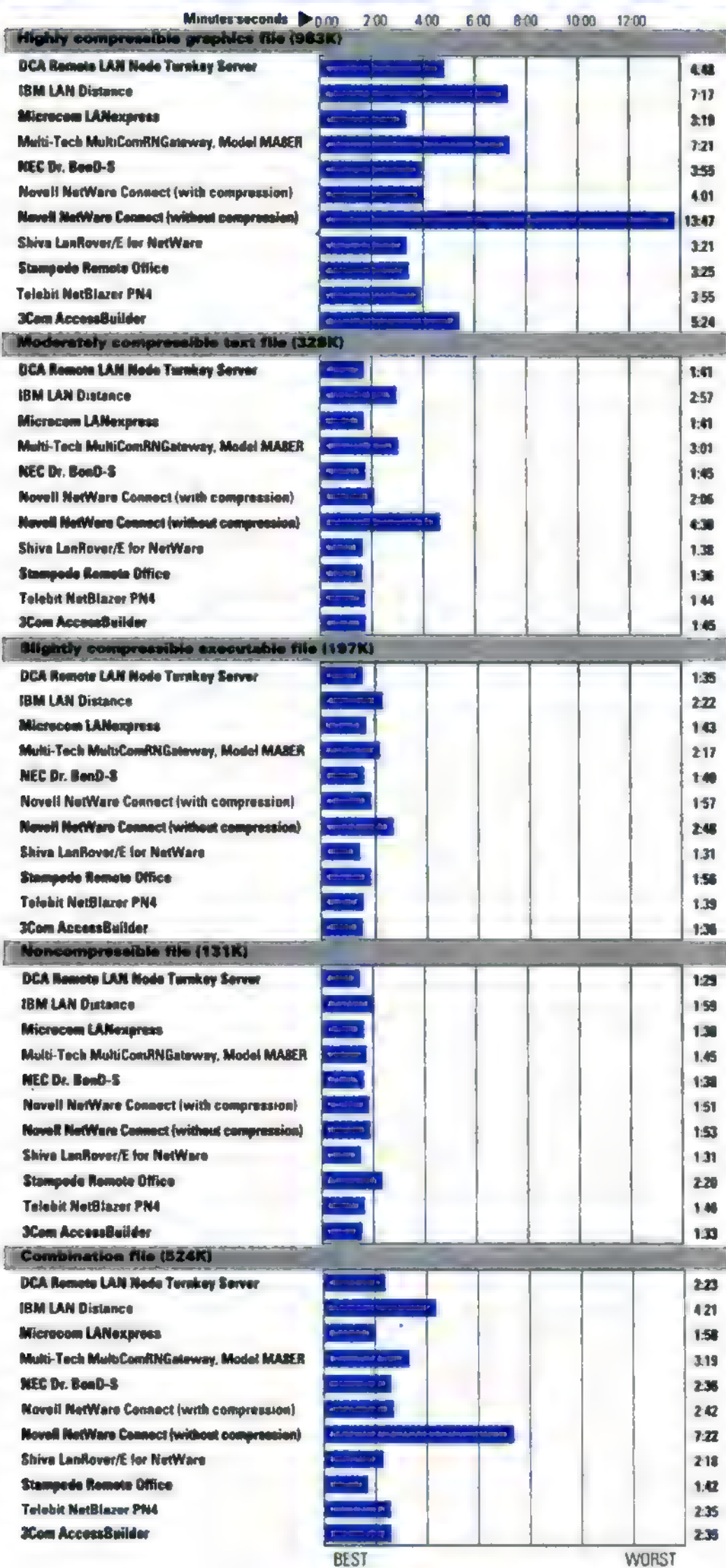
We used two test-beds—a management test-bed to evaluate feature sets and manageability and a performance test-bed to test transfer speeds for various file types. For our management test-bed, we used 28.8-Kbps V.Fast Class External BocaModems to connect our remote-node clients. For our performance test-bed, we set up a NetWare 3.12 network running over Ethernet on one side, and a DOS/Windows remote client on the other side. For the analog modem line, we used equipment from Processing Telecom Technologies (PTT), configured to simulate a good connection from San Francisco to Los Angeles. On each side, we used a Practical Peripherals PM14400FXSA, a 14.4-Kbps modem with built-in V.42bis compression. With the Microcom LANExpress, however, we used the Microcom V.FC—the 28.8-Kbps internal modem bundled with the server.

We performed both **DOS-Based IPX File Transfers**, using the copy command, and **Windows-Based IPX File Transfers**, using the File Manager, from the NetWare file server to the remote client. On the client side, we provided NetWare VLM client drivers for all the products that supported them. Although only the LANExpress and LanRover/E shipped with VLM software, six other products—the Remote LAN Node Turnkey Server, IBM LAN Distance, NetWare Connect, Remote Office, the NetBlazer, and the AccessBuilder—support user-provided VLMs. VLM and NETX software is included with NetWare 3.12 and 4.01, or you can download it from CompuServe. Since we ran our tests, Remote Office 1.3 was released; it includes VLM software.

Note that we were unable to run our Windows-based file transfers on NEC's Dr. BonD-S, which does not support Windows. And LAN Distance offers a native OS/2 client but no native DOS client, so we performed the DOS-based



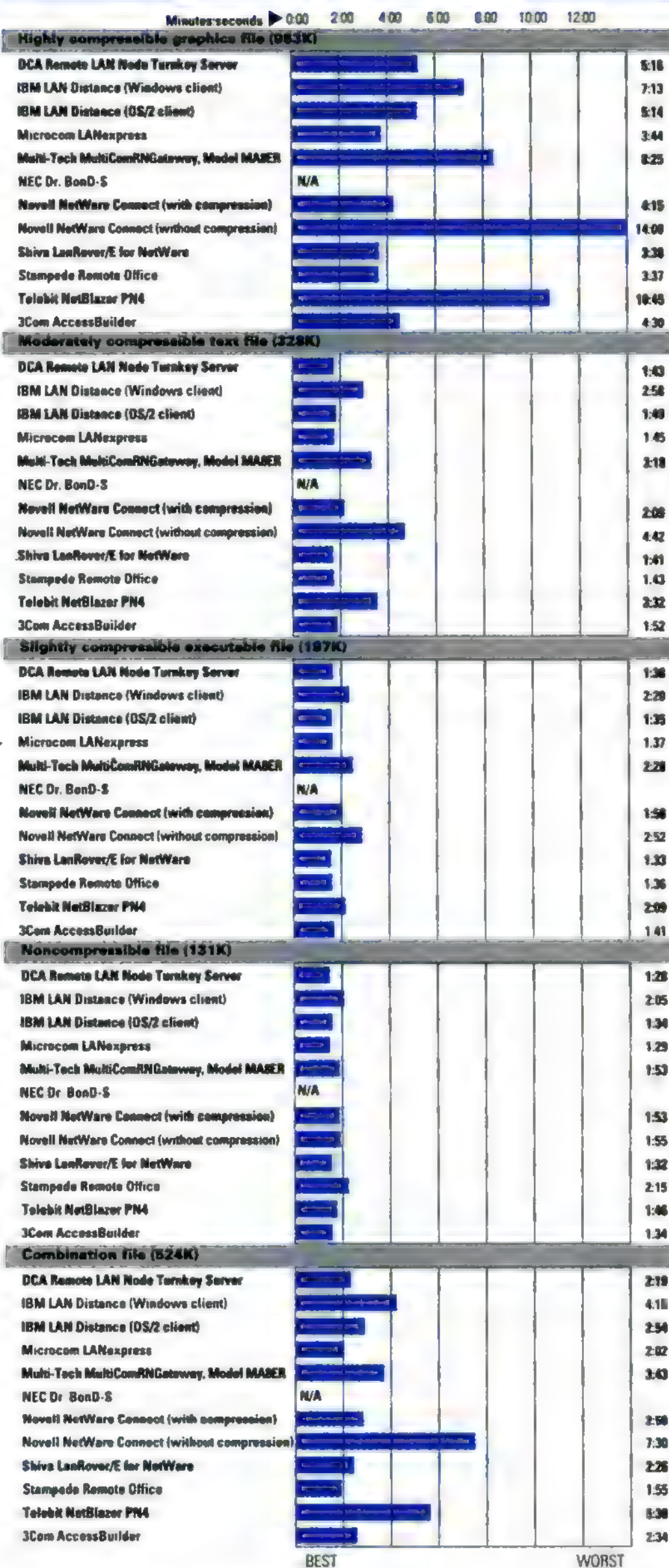
DOS-BASED IPX FILE TRANSFERS



transfers using a DOS box within Windows. For the Windows-based tests we report LAN Distance's transfer times for both a Windows client and an OS/2 client. We tested NetWare Connect with and without compression because this product uses compression only if expanded memory is available.

For each test, we timed the file transfer twice and averaged the results. We used five types of files: a 983K **highly compressible graphics file**, a 328K **moderately compressible text file**, a 197K **slightly compressible exe-**

WINDOWS-BASED IPX FILE TRANSFERS



N/A—Not applicable. This product does not support Microsoft Windows.

cutable file, a 131K **noncompressible file** (similar to a PKZip file), and a 524K **combination file** that contained some highly compressible parts and some noncompressible parts.

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Version 6.0



October 15, 1991
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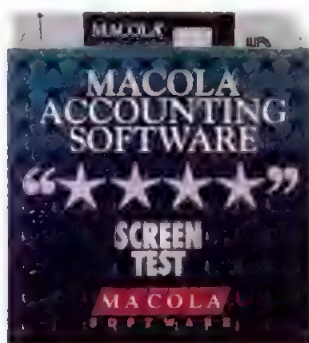


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Remote-Node Servers

FACT FILE

Remote LAN Node Turnkey Server

List price: With 4 ports, \$3,845; with 8 ports, \$5,390; additional client software packs: for 5 users, \$335; for 10 users, \$630; for 20 users, \$1,120.

In short: RLN is a fairly complete turnkey solution that provides good security and works with multiple protocols and network operating systems. Installation, however, was not as easy as with some others in this roundup. And its lack of dial-out support in combination with a high price (for this field) may send you looking elsewhere.

Digital Communications Associates Inc.,
1000 Alderman Dr.,
Alpharetta, GA
30202, 800-348-3221,
404-442-4000; fax,
404-442-4366.

507 on reader service card

SUITABILITY TO TASK

Installation and configuration	FAIR
Management	GOOD
Dial-in	GOOD
Dial-out/ LAN-to-LAN	POOR

need to spend less money, and would like a simpler installation, you should look at some of the other products here, such as Shiva's LanRover/E or the Microcom LANexpress.

IBM Corp.

• IBM LAN Distance, Version 1.1

BY STEVE RIGNEY

Well-priced at \$595 for a software-only eight-port license and \$1,995 for more than eight ports, IBM LAN Distance is an OS/2-based remote-access server that runs on a nondedicated OS/2-configured PC. It supports OS/2- and Windows-based clients on Novell's NetWare, Microsoft Windows for Workgroups, and Artisoft's LANtastic networks. You should note, however, that it has no DOS client software, and it was one of the slow-

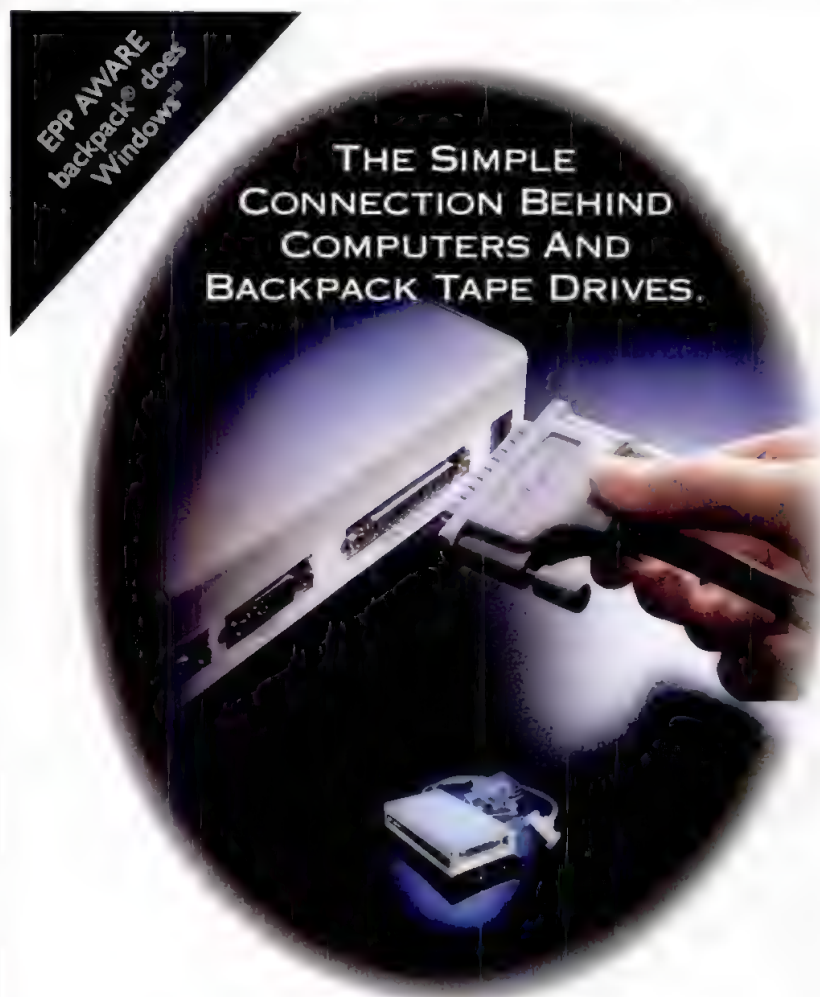
er performers in this field.

LAN Distance does have some unique security features, independent hardware support, graphical client and server interfaces, and flexible multiprotocol support. It is the only remote-node server in this roundup to take advantage of OS/2's powerful 32-bit masking capabilities.

On the other hand, although our tests showed that LAN Distance is ideal for you

if you are an OS/2 user, it may give you a headache if you use Windows or DOS. In addition, LAN Distance's dial-in capabilities are limited to LAN-to-LAN connections. If you need dial-out and remote functionality, you will need to look elsewhere to find the right remote-node server.

OS/2's multitasking capabilities allow the LAN Distance server to run on a nondedicated PC, unlike NetWare Con-



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IBM Lan Distance is the only remote-node server in this roundup to take advantage of OS/2's powerful 32-bit masking capabilities.

▪ But I Don't Have NetWare

By Robert P. Lipschutz

All of the products in this roundup will let you connect to your NetWare network from home or from the road. They all support IPX, NetWare's network-layer protocol. But what if you have a different network operating system that uses a different network protocol?

If you use any of Microsoft's networking packages, a TCP/IP-based network, or a peer-to-peer product, read on. In most cases, you have a variety of remote-access products to choose from. Many of the products in this review, for example, also support some of these other network OSs. You need to make sure that the remote-node server portion of a product supports your network protocol and know whether the network client driver is included with the product or available elsewhere.

Two flavors of remote-node server are available: protocol-dependent and protocol-independent. Protocol-dependent products, called routers, must support the desired network protocol. Telebit's NetBlazer PN4, for example, supports TCP/IP in addition to IPX. Protocol-independent products, called bridges, support all network protocols. The DCA RLN will work with all network protocols. (See the Summary of Features.)

Getting the remote-node server straight is only half the equation. You must also have the client drivers that

will reside on remote users' PCs. A client driver is analogous to an Ethernet driver, except that it sends data to the COM port and through the modem rather than to an Ethernet adapter. Network drivers ship with either the remote-node product or the network OS itself.

Here's what you can expect for remote-access support with some of the other network OSs.

MICROSOFT EMBRACES NETWORKING

The introduction of Windows for Workgroups (WfWG) then Windows NT Advanced Server (NTAS) signaled only the beginning of Microsoft's networking plans. Its network services, bundled in both WfWG and NTAS, include the Remote Access Services (RAS). In addition, it expects to ship a new version of Windows (called Chicago) by the end of this year that has many network enhancements.

RAS includes the network client driver and has three different connection scenarios for remote access: via a local Chicago or WfWG client, via a local NTAS RAS server, or via a local third-party product that supports Microsoft networking. Once connected, you have complete access to all networking files on Windows NTAS, WfWG, or other Chicago machines.

TCP/IP GAINING GROUND

Most workstation-based networking and an increasing amount of PC-based

networking is done using the Internet standard TCP/IP protocol. TCP/IP is designed to be complete with everything you need. Thus, among other offerings, most TCP/IP software packages include remote networking client software. Therefore, you'll only have to ensure that the remote-node server supports the TCP/IP protocol.

APPLES TALK

Apple offers an AppleTalk network client driver called Apple Remote Access (ARA) Client for Macintosh. Using ARA, you can mount remote volumes as icons in the same way you mount volumes from your local network. Many people use ARA to connect Apple computers directly, but a remote-node server that supports AppleTalk can also serve as an ARA host.

PEER-TO-PEER, TOO

If you have a peer-to-peer network, contact the vendor about remote-access options. Some have products designed specifically for remote access. For example, Artisoft's Central Station II for LANtastic allows users on the road to access a LANtastic network.

And if all this doesn't work, you can always use remote control, which can be used with any network OS (see "How to Be in Two Places at Once"). No matter what NOS you have, you'll be able to connect from the road. □

nect, which runs on NetWare. But you probably will want a dedicated system for your remote server anyway.

In addition, LAN Distance includes a 32-bit OS/2 remote-client software package. LAN Distance works with any promiscuous-mode Ethernet or Token-Ring network adapter that supports the NDIS protocol and any I/O card that includes a device driver to communicate with the NDIS API.

Remote-client security is one of LAN

Distance's strong points. In addition to working with the built-in security of your network operating system, LAN Distance provides pass phrases, encryption, log-on limits, filters, and physical-unit IDs. Pass phrases can be from 4 to 32 characters long, and you have the flexibility of using spaces and different case letters and characters. The physical unit ID allows you to set up security based on a specific PC, and not just a user name and password.

In our tests, we installed the OS/2 client

in a matter of minutes. Installations of the OS/2 server, however, and the Windows client were difficult. Our test client was using NetWare's VLM drivers, and IBM admits to incompatibility with NetWare's Burst Mode network transfers. Pricing is flexible for client upgrades. You can upgrade a single client from Version 1.0 to 1.1 for \$39 or to an eight-port version for \$120.

Similar to DCA's Remote LAN Node Turnkey Server, the LAN Distance functions as a MAC (media-access control)

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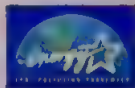


CIRCLE 147 ON READER SERVICE CARD

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Created in Fractal Design Painter by Glenn Mitsui



FACT FILE

IBM LAN Distance, Version 1.1

List price: Software for 8 ports, \$595; software for 1 remote client, \$69. Upgrade from Version 1.0: software for 8 ports, \$120, software for 1 remote client, \$39. **In short:** If you are running OS/2 in a system that could double as a remote-node server, IBM LAN Distance is a well-priced remote-node dial-in server solution for your OS/2 and Windows clients. It includes excellent security features and flexible multiprotocol support. It was, however, a slow performer on our tests. And if your remote traffic increases you will eventually require a dedicated machine. In addition, installation of the Windows client

gave us a few problems.

IBM Corp., 11400 Burnet Rd., Austin, TX 78758, 800-342-6672, fax-back, 800-426-4329.

508 reader service card

SUITABILITY TO TASK

Installation and configuration	POOR
Management	GOOD
Dial-in	FAIR
Dial-out/LAN-to-LAN	FAIR

dows, which is remote-control software. The LANexpress utilities make server management and remote access relatively simple.

LANexpress supports Novell's NetWare, Microsoft Windows NT, Banyan's VINES, and TCP/IP network operating systems over Ethernet and Token-Ring. Up to four modem adapters (each with two ports) with speeds of 115.2 Kbps can be installed, making a total of eight possible ports per server.

The server is shipped with software loaded, and set up was easy except for one minor hitch. The LAN adapter arrived pre-configured for BNC. In order to connect over 10BaseT we had to open the box and reconfigure jumpers to select AUI connection. This connects through a transceiver to provide 10BaseT hookup.

Installation also was easy, involving just a few simple questions. Upon startup, expressWatch initiates an autodiscovery process that continually identifies all LANexpress servers that are attached and active. This process runs in the background. And as you don't have to load TCP/IP, configuration is easy. Unlike DCA's Turnkey server, LANexpress runs over an ODI IPX driver. Multiple servers can be monitored with a single copy of expressWatch, or each server can be monitored by multiple expressWatch utilities.

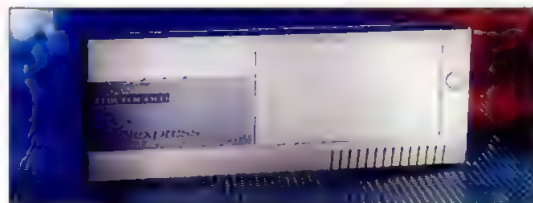
For security, LANexpress provides control sessions that prevent multiple management stations from performing simultaneous writes to the same device.

LANexpress only accepts calls from PCs running LANexpress Remote software. Each port can be configured as dial-in, dial-out, or both. When dial-in security is enabled, each user can be assigned privilege levels such as non-dial-back, fixed dial-back, roaming dial-back, or roaming dial-back with pass-through access. This last one is useful if remote users call from a telephone that cannot accept a callback. Similar access privileges can be assigned for dial-out.

Installing a NetWare client (included in the LANexpress package) and LANexpress Remote was easy. Users can de-

fine a list of phone numbers of frequently called LANexpress servers, along with a log-on name and password. Configuring application, terminal-emulation, or e-mail execution upon connection was simple.

Microcom provides a toll-free user-



The Microcom LANexpress arrives with the LAN card pre-configured for BNC, so you have to open up the box if you need to reconfigure the jumpers to another connection.

support hot line and a bulletin board for downloading software upgrades. LANexpress also has a 90-day software and 1-year hardware warranty.

LANexpress is an impressive, complete system with software to match. Its great user interface makes it easy to use. LANexpress also provides remote-node and remote-control access, and it includes dial-out capability.

FACT FILE

Microcom LANexpress

List price: With 4 ports Ethernet, \$4,999; Token-Ring, \$5,899 (for each, price includes unlimited network license of Carbon Copy remote-control software), remote-client software for 1 user, \$50, for 10 users, \$450, for 50 users, \$2,000, for 100 users, \$3,500. **In short:** Microcom LANexpress is an impressive integrated system with software and modems built right in. It offers a great user interface, dial-out capability, and both remote-node and remote-control access. With its preloaded software, setup went easily, and its management facilities are very good. The price is a little steep, though you do get a lot of remote package for your money.

Microcom Inc., 500 River Ridge Rd., Norwood, MA 02062, 800-822-8224; fax, 617-551-1021.

509 reader service card

SUITABILITY TO TASK

Installation and configuration	EXCELLENT
Management	GOOD
Dial-in	EXCELLENT
Dial-out/LAN-to-LAN	GOOD

bridge. LAN Distance works with IPX, TCP/IP, NetBEUI, NetBIOS, and VINES protocols, giving you access to NetWare, Microsoft Windows for Workgroups, and LANtastic networks.

If you need a strong 32-bit multitasking access server for your OS/2 remote-node clients, IBM LAN Distance is probably your best choice. Strong security and multiprotocol support contribute to LAN Distance's appeal, but weak Windows capability and no DOS client or dial-out support may scratch LAN Distance from your list.

Microcom Inc.

Microcom LANexpress

BY VISHY NARAYAN

Microcom packs a sizable punch with its Microcom LANexpress desktop remote-node server. The LANexpress, at \$4,999, is loaded with features and includes four 28.8 Kbps modems. Yet it is easy to use, with a point-and-click user interface that provides a one-call connection to both remote-node and remote-control applications and dial-out capability without ever leaving Microsoft Windows.

The LANexpress package includes expressWatch, a real-time network management software utility; LANexpress Remote, which allows remote users access to LAN resources via the server; and an unlimited license to Carbon Copy for Win-

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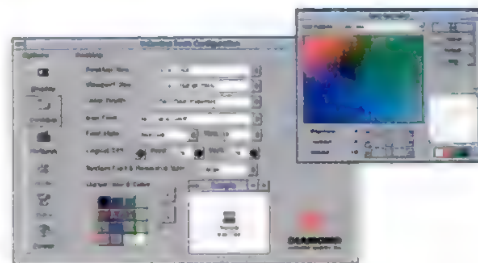
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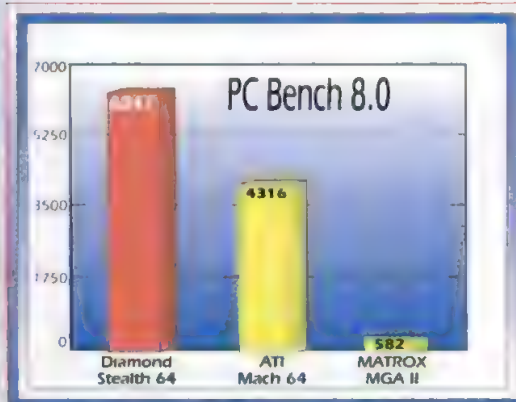
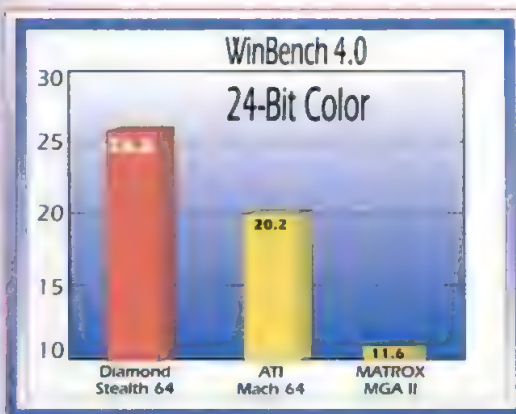


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Computer Systems, Inc.

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WINDOWS

GAMES & DOS



Performance tests conducted by Diamond Computer Systems, Inc. using ZiF Davis's WinBench Version 4.0 on a Pentium 66MHz PCI system at 800x600x16M, 1F with 256k cache, 8MB RAM, SmartDrive 2048, and DOS 6.2. The Stealth 64 was configured with 2MB VRAM using driver release v1.03. The ATI Graphics Pro Turbo Mach 64 was configured with 2MB VRAM using driver release v1.01. The Matrox MGA II Ultima Plus was configured with 2MB VRAM using driver release v1.32. All trade names referenced are the service mark, trademark, or registered trademarks of the respective manufacturers. Diamond reserves the right to change specifications without notice. Copyright © 1994 Diamond Computer Systems, Inc. 1130

CIRCLE 176 ON READER SERVICE CARD

► SUMMARY OF FEATURES

Remote-Node Servers

PC MAGAZINE
EDITORS' CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	DCA Remote LAN Node Turnkey Server	IBM LAN Distance	Microcom LANexpress	Multi-Tech MultiComRN- Gateway, Model MAKEN	NEC Dr. Bond-S	Novell NetWare Connect	Shiva LanRover/E for NetWare
Hardware or software	Both	Software	Both	Both	Both	Software	Both
List price (tested configuration)	\$3,845	\$595	\$4,999 (includes 4 modems)	\$3,499	\$3,090	\$2,195	\$2,899
Supports bridging	■	■	■	□	□	□	□
Software version tested	2.0	1.1	1.1	2.0	1.22.2	1.0	2.1
Firmware version tested	2.0	N/A ①	1.1	1.01	1.22.2	N/A ①	2.1
Number of ports on tested unit	4	N/A ①	4	8	4	N/A ①	4
Ethernet/Token-Ring support available	■ ■	■ ■	■ ■	■ □	■ □	■ ■	■ ■
Licensing							
Client software distributed free of charge	□	□	□	■	□ (third party)	■	■
Unlimited number of user names	□	■	■	■	■	■	■
Multiple simultaneous log-ons with single name	■	■	■	■	□	■	■
Functions							
Dial-in remote node	■	■	■	■	■	■	■
Dial-out modem pooling	□	□	■	■	■**	■	■
Redirects Windows comm port	N/A ②	N/A ②	■	□	□	□	■
Supports NASI	N/A ②	N/A ②	■	■	□	■	■
Supports interrupt 14h	N/A ②	N/A ②	□	■	□	■	■
Remote-control software included	None	None	Carbon Copy for Windows	MultiExpress for DOS	None	None	None
Dial-up routing	□	■ (TCP/IP only)	□	□	■	□	■
Hardware							
Platform	Integrated unit	PC	Integrated unit	Integrated unit	Integrated unit	NetWare server	Integrated unit
Processor type/RAM	486SX/25, 4MB	N/A ①	486/25, 16MB	486/25, 2MB	386SX/25, 4MB	N/A ①	68020/25, 1MB
Maximum number of ports supported	16	128	8	16	20	64 per server	8
NOS/Network Protocols Supported on Server							
NetWare 3. x and 4. x (IPX)	■	■	■	■	■	■	■
VINES 4. x and 5. x (VinesIP)	■	■	■	□	□	□	□
LANtastic	■	■	□	□	□	□	■
TCP/IP	■	■	■	■	■	■	■
AppleTalk	□	□	□	□	□	■	□
NetBEUI	■	■	■	□	□	□	■
Client Platforms Supported							
DOS	■	□	■	■	■	■	■
Microsoft Windows 3.1	■	■	■	■	□	■	■
OS/2	□	■	□	□	■	□	□
Frame Types Supported							
Ethernet II (TCP/IP default)	■	■	■	□	■	■	■
Ethernet 802.2 (NetWare 3.12 default)	■	■	■	■	□	■	■
Ethernet 802.3 (NetWare 3.11 default)	■	■	■	■	■	■	■
Ethernet SNAP (AppleTalk default)	■	□	■	□	□	■	■
Memory Requirements							
Conventional memory used by client drivers	58K	100K (Windows), 260K (OS/2)	22K	60K	25K	42K	15K
NetWare utilities included: LOGIN/LOGOUT/MAP	□ □ □	□ □ □	■ ■ ■	■ ■ ■	□ □ □	■ ■ ■	■ ■ ■
Compression Schemes							
Run length encoding	■	□	■	■	□	□	■
Lempel-Ziv-Welch	□	□	■	■	□	□	■
Header compression	■	□	□	□	■	□	■
Security							
Password protection for remote-client log-on	■	■	■	■	■	■	■
Can integrate log-on with NetWare's Bindery	□	□	□	□	□	■	■
Dial-back support	□	■	■	□	■	■	■
Roaming dial-back support	□	■	■	□	□	■	■
Management							
Management platforms	Windows	OS/2	Windows	DOS	None	NetWare	Windows, Macintosh
Console/telnet	■ □	□ □	□ □	□ □	■ ■	■ ■	■ ■
SNMP support	■	■	■	□	■	■	■
Activity logs	■	■	■	■	■	■	■

* The tested version of Stampede Remote Office was bundled with an optional four-port DigiBoard 4E adapter. ** This product does not support dial-out modem pooling for IPX.

①—Not applicable. This product is software only. ②—Not applicable. This product does not support dial-out modem pooling or offers it as a third-party option.

Multi-Tech Systems Inc.

• MultiComRNGateway, Model MA8ER

BY GARRY FRENKEL

MultiComRNGateway, Model MA8ER, is positioned as an all-purpose, turnkey communications server for NetWare networks. For a comprehensive system, it required a fair amount of up-front configuration, but with its simple client setup and good management utilities, it ends up being easy to use and administer.

Besides providing remote-node services for Windows and DOS clients, Multi-Tech Systems includes unlimited copies of software for dial-out, remote-control, and fax services. Its pricing reflects the rich functionality: the eight-port version costs \$3,499 with a 486SL CPU and \$3,999 with a 486DX.

The RNGateway is built on the Multi-Tech MiniArray communications server, which has a four-slot passive backplane in a cabinet with a floppy disk drive, power supply, and cooling fan. Installed is a 486DX or SL Single Board Computer (SBC) with 4MB of RAM, a NetWare-compatible Ethernet network adapter, and at least one eight-port intelligent ser-

ial interface adapter, capable of supporting up to eight 57.6-Kbps sessions.

As a turnkey solution, the RNGateway has a few quirks. For example, the Ethernet media (coax or UTP) selection switch should be accessible from the back of the device, and the IRQ setting software should be selectable. Rather than relying on Multi-Tech's other PC-based model's documentation, the server should have its own.



Multi-Tech's MultiComRNGateway, Model MA8ER, is a comprehensive package including a floppy disk drive and a power supply, with a 486DX or SL Single Board Computer.

To configure the server you attach a monitor and keyboard to the SBC's ports (you can also use the included management software and configure the unit from another PC). Because the unit has no hard disk you load the software from the floppy disk drive, which is slow and tedious. After a couple of rounds with Multi-Tech technical support, we were told to try loading the software from a RAM drive—a much faster process.

You can easily define dial-in users with passwords and call-back options, but there is no time-of-day stamp. And although RNGateway is NetWare-specific, it is not integrated with the NetWare Bindery. You'll need to keep two lists. Configuring the server was awkward—unnecessary keystrokes, some unclear prompts, and a Tab keystroke that wasn't recognized by the software. Remote-node installation was painless; it copies all necessary files to the specified subdirectory. You run the client software in menu-driven or command-line mode, from Windows or a DOS window.

RNGateway also displays a warning with the file size and download time when

► FACT FILE

MultiComRNGateway, Model MA8ER

List price: With 8 ports and 486SL CPU, \$3,499; with 8 ports and 486DX CPU, \$3,999; price includes unlimited copies of client software. **In short:** The MultiComRNGateway, Model MA8ER, is a turnkey solution, providing remote-node access, as well as remote control, fax service, and dial-out software. It does have some drawbacks. It was a slow performer and, for a turnkey solution, the server required more initial configuration than it should, although client installation went flawlessly. Multi-Tech does offer pretty good management and was easy to use once configured.

Multi-Tech Systems Inc., 2205 Woodale Dr., Mounds View, MN 55112; 800-328-9717, 612-785-3500; 612-785-9874.

510 on reader service card

SUITABILITY TO TASK

Installation and configuration	FAIR
Management	FAIR
Dial-in	GOOD
Dial-out/ LAN-to-LAN	FAIR

Stampede Remote Office Telebit NetBlazer PN4 3Com AccessBuilder

Software*	Both	Both
\$1,295*	\$2,999	\$3,495
■	□	■
12	23	405
N/A ①	10	405
4*	4	4
■ □	■ □	■ ■
□	■	■
■	■	■
■	■	■
Optional	■**	□
N/A ②	□	N/A ②
N/A ②	■	N/A ②
N/A ②	■	N/A ②
None	None	None
□	■	■
PC	Integrated unit	Integrated unit
N/A ①	386DX/20 4MB	i960/20, 5MB
32	4	16
■	■	■
■	□	■
■	□	■
■	■	■
□	■	■
■	□	■
■	■	■
■	■	■
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24K	48K	64K
■ □ □	□ □ □	□ □ □
■	□	□
■	□	□
■	■	■
■	■	■
□	□	□
■	□	■
■	□	□
DOS	Windows	None
□ □	■ ■	■ □
■	■	■
■	■	■

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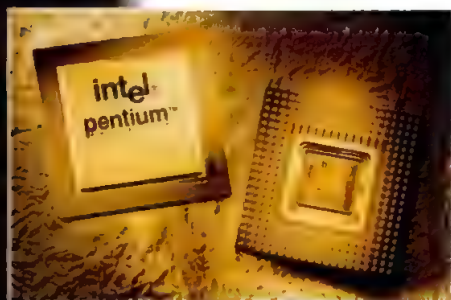
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Remote-Node Servers

you try to load an .EXE file from the remote file server. This prevents a user from carelessly trying to load a large program across the slow telephone line.

Multi-Tech provides strong management functions. The SERRCON utility lets the LAN manager view the status of the server and its communications lines and add to or change the list of authorized users. The SERLOG utility provides logs with detailed and summary usage information by user or port. But you have to bring down the server to run SERRCON.

RNGateway is a comprehensive system. Beyond difficult configuration and the necessity to bring the server down to run the SERRCON utility, it is easy to use and has good management capabilities.

NEC America Inc.

• Dr. BonD-S

BY J. C. LOVE

In a recent roundup of dial-up router devices, *PC Magazine* designated the Dr. BonD-S an Editors' Choice ("Speaking LAN to LAN," May 31, 1994). Unfortunately, NEC America's approach to offering the Dr. BonD-S as a remote-node server on a NetWare LAN has a ways to go. One drawback is that it does not support remote Windows clients—only DOS and OS/2.

Installation is clear enough and well documented, but the remote software for DOS clients is clumsy. Moreover, along with the \$3,090 price, you have to pay for Novell's LAN WorkPlace for DOS or OS/2 software (\$395 for a single DOS user, \$399 for a single OS/2 user) for each

► FACT FILE

Dr. BonD-S

List price: \$3,090, client software must be purchased from a third-party vendor. **In short:** Although it is a great dial-up router, the Dr. BonD-S is not your best choice as a remote-node server solution—especially if you need to connect Microsoft Windows clients. The Dr. BonD-S has support only for DOS and OS/2 clients. Interestingly, installation is easy, but even the remote DOS-client software is clumsy. If you need a remote-node server for telnet sessions with a Unix host from remote-based PCs, then the Dr. BonD-S will work. Beyond that, the Dr. BonD-S has only IP dial-out capability.

NEC America Inc.,
1525 W. Walnut Hill
Ln., Irving, TX 75038;
800-222-4632/214-
518-5000; fax, 214-
518-5572.

511 on reader service card

SUITABILITY TO TASK

Installation and configuration **POOR**

Management **FAIR**

Dial-in **POOR**

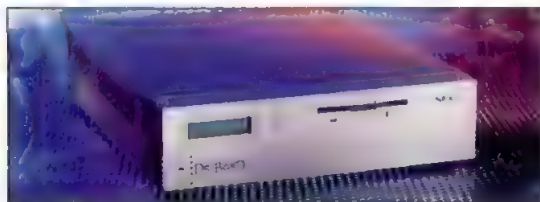
Dial-out/
LAN-to-LAN **FAIR**

remote client. This adds to expense and complexity. In addition, dial-out capability is limited to that under the TCP/IP protocol.

Each time you power up The Dr. BonD-S, it boots from its floppy disk and shows its progress in the front-panel LCD. The LCD and two control buttons let you assign an IP address so you can configure the unit from a network telnet session. You may find it easier to attach a terminal to the primary asynchronous port connector.

You use a slide switch to select either the 10BaseT or thinnet connectors provided, but if you need a thicknet (AUI) connection, you'll need to install an appropriate adapter. NEC provides 4 asynchronous ports, and you can add two more 8-port asynchronous adapters for a maximum of 20 ports. The Dr. BonD-S will take four internal modems.

The management and configuration software works great for dial-up routing but is confusing for using the Dr. BonD-S as a remote-access server. Finding the right option was often a process of trial and error. For example, the unit does not support dial-out for NetWare clients but does support it for TCP/IP; you cannot, however, use the same name for remote access and modem pooling.



By displaying its progress in the LCD front panel, the Dr. BonD-S lets you know what is happening each time you boot from the floppy disk.

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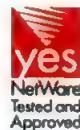
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The actual approach to remote-node access on NetWare LANs is not optimal. NEC uses IP Tunneling, which is where Novell's LAN WorkPlace for DOS comes into play. Each IPX packet is encapsulated in an IP packet for transfer. (NEC says it is working on a native IPX method.)

Installation of the LWDIAL software for the remote client requires that LAN WorkPlace be found in its default installation directory. It assumes that the client will only be used for remote access, as it replaces the NET.CFG file both in its own directory and in the root with one that works for only a single user, specifically and only with LWDIAL.

Once it is installed, you can easily make a remote connection. And in testing, once a link was established, the Dr. BonD-S maintained its logical user connection to the NetWare server even when cables were disconnected. A new log-on was required only when the NetWare server went down.

The Dr. BonD-S is a good choice if your only requirement is for telnet sessions with a Unix host from remote DOS-based PCs. If you need more than that, especially Windows client support, multiple network OS support, and dial-out capability, you'll need to look elsewhere or wait until NEC creates a more comprehensive remote-access server package.

Novell Inc.

• NetWare Connect

BY GARRY FRENKEL

With NetWare Connect, Novell wants to create a comprehensive solution for remote NetWare connectivity. It has bundled remote-node dial-in, LAN-based dial-out, and a platform for NetWare-only remote control in one package.

On the downside, Windows is not fully supported, installation is not for the uninitiated, and the client user interface is not easy to use. On our tests, performance was slow at first because the client software disabled our modems' V.42bis hardware compression. According to Novell, NetWare Connect does all compression in software—and only if the Expanded Memory Manager (EMM) driver is loaded. Performance improved dramatically when we loaded this driver, and EMM not only uses up extra memory, but it complicates the process.

▶ FACT FILE

NetWare Connect

List price: Software: for 2 ports, \$595; for 8 ports, \$2,195; for 32 ports, \$5,995. **In short:** Although not the best solution in the bunch, NetWare Connect offers great potential towards a complete solution for LAN remote access. It is well integrated with Novell's NetWare and includes remote-node, dial-out, and remote-control support for PCs and Macs. Note, however, that NetWare Connect has a misleading default setting that can lead to poor performance, and that its server installation and configuration will require prior NetWare installation experience. The PC client software also needs improved Windows support.

Novell Inc., 122 E
1700 South, Provo,
UT 84606, 800-453-
1267, 801-429-7000;
fax, 801-429-5155.
512 on reader service card

SUITABILITY TO TASK

Installation and configuration	FAIR
Management	GOOD
Dial-in	POOR
Dial-out/ LAN-to-LAN	GOOD

Still, if some of these issues are addressed, there's no doubt that NetWare Connect, with its strong NetWare integration, can set the standard by which this category of product is measured.

NetWare Connect is available in a 2-port version at \$595, an 8-port version at \$2,195, or a 32-port version at \$5,995.

Even though the documentation is fairly comprehensive, you should have experience installing NetWare 3.x or later before you attempt to install and configure NetWare Connect. Configuring the third-party hardware requires some detective work, because Novell supplies drivers for a number of popular products but doesn't tell you where the drivers are or what to do with them.

NetWare Connect can be configured either directly from the server console or remotely using NetWare's RCONSOLE utility. Ports can be configured as dial-in, dial-out, or both, which allows them to be dynamically allocated as necessary.

With NetWare's Bindery, you can configure users to have access to specific ports and services, like dial-in and dial-out, restricted as to the time allowed online, and specified to require dial-back. After you finish configuration you can generate a report that details each installed service, the defined ports, and all defined groups.

On the client side, NetWare Connect supports both PC and Macintosh remote

nodes. To install the client software, you copy some standard NetWare utilities, such as LOGIN and MAP, and files from the file server's new NRN subdirectory. Then the DIALCON utility configures the remote-node driver and makes connections to the remote host.

NetWare Connect's client software is not well developed yet, and this could be inconvenient for remote users. And, unlike products such as Stampede's Remote Office, NetWare Connect does not let the user create a phone book, although Novell is working on one.

Remote-node access worked well until we tried to run Windows. It turns out that Windows will not query the modem's comm port when the NRN driver is running. You can fool Windows into thinking there are fewer comm ports installed, but this approach carries a serious drawback. First, your mouse must always be attached to COM1, a situation you might live with. But worse is that none of your Windows applications can access your modem, even



NetWare Connect, a software-only package for remote-node service, is well integrated with the NetWare network operating system.

when NRN is not running, unless the SYSTEM.INI file is modified. This could be a showstopper for many users.

NetWare Connect carries plenty of potential, but it still needs work.

Shiva Corp.

EDITORS' CHOICE LanRover/E 2.1 for NetWare

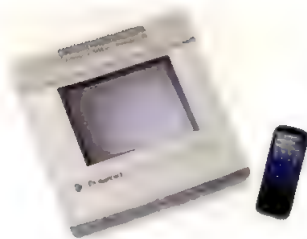
BY STEVE RIGNEY

Another in a long line of powerful remote-access servers from Shiva Corp., the LanRover/E for NetWare provides complete dial-in and dial-out access for both Windows- and DOS-based PCs on an

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LanRover/E 2.1 for NetWare

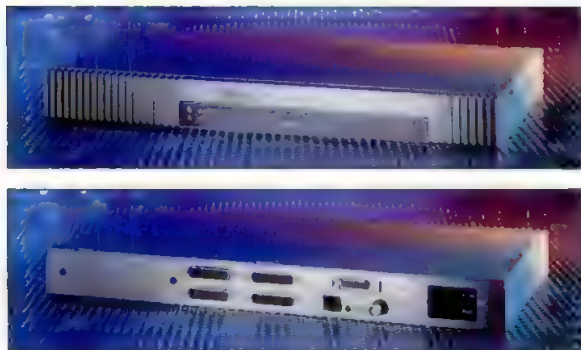
List price: With 4 ports, \$2,899, with 8 ports, \$3,999, unlimited copies of client software included in unit price. **In short:** Priced well for what it provides, with excellent performance, the LanRover/E 2.1 for NetWare is impressive for its simple installation and configuration as well as its ease of use. It provides both dial-in and dial-out capabilities, as well as good security and management features. It's not a total turnkey solution, but you can use the modems you already have (it supports more than 100), and it installs as easily as any turnkey here.

Shiva Corp., Northwest Park, 63 Third Ave., Burlington, MA 01803, 800-458-3550, 617-270-8300, fax, 617-270-8599, 513 on reader service card

SUITABILITY TO TASK		
Installation and configuration		EXCELLENT
Management		GOOD
Dial-in		EXCELLENT
Dial-out/LAN-to-LAN		EXCELLENT

Ethernet LAN. It offers excellent security and management, and the Shiva product was one of the top scorers on our performance tests. The LanRover/E includes drivers for ODI, NDIS, and NETX, supports NetWare's Virtual Loadable Modules (VLMs), includes a license for unlimited copies of the client software, and takes about 10 minutes to install and configure. You supply the modems and serial cables.

The LanRover/E is available in either a four-port configuration for \$2,899, which we tested, or an eight-port configuration, which sells for \$3,999. We tested the Windows version of the Shiva Network Manager (it also ships with a Macintosh version). It lets you set up and configure the LanRover/E, add users, log connections, and troubleshoot server problems.



Shiva's LanRover/E provides you with all you need for easy remote access—simple installation and configuration, and good management and security features.

In addition to monitoring all your LanRover/E servers, the Shiva Network Manager also controls other Shiva remote-access products, such as the NetModem/E. Other products in this roundup, such as Stampede's Remote Office, do not offer centralized management for multiple remote-access servers.

You can set up individual users, groups, and passwords either with the Shiva Network Manager or by importing user and security data from the NetWare Bindery. In addition, you can restrict users to only dial-in or dial-out privileges, limit the dates and times a particular user or group can access the network via remote node, and use call-back to protect your network resources further from remote callers.

The LanRover/E supports multiple protocols, including IPX, IP, NetBEUI, and Logical Link Control (LLC). Shiva includes drivers for ODI and NDIS and handles the PPP and SLIP serial protocols. LanRover/E's support for Novell's VLM drivers lets you connect to a remote-node server without exiting Windows to load the network drivers. VLM support is an important feature if you run Windows and only need to connect to your access server a few times a day, and you don't want to tie up a connection when the server is not in use.

In addition to dial-in remote access, the LanRover/E provides dial-out capabilities across the network. You can use the Shiva Connection software to redirect a comm port to a LanRover/E installed on the network and use any Windows-based communications package to dial-out across the LAN to other servers or services such as CompuServe.

Although the LanRover/E also supports dial-out access for Windows and DOS clients, you have to use a communications package that supports interrupt 14h or NetWare Asynchronous Interface (NASI).

Even though you provide the modems, the LanRover/E 2.1 for NetWare is an otherwise complete turnkey remote-access solution and is as easy to install as similar products that provide all of the hardware and software in a single package. Net-

work Manager contributes to LanRover/E's extremely easy setup and configuration. (Version 3.0 was preparing to ship as we went to press. It adds security features, ISDN support, and routing.)

Stampede Technologies Inc.

• Remote Office, Version 1.2

BY GARRY FRENKEL

At \$1,295 for the four-port version, Remote Office is a low-cost remote-access solution that is easy to install, configure, and use. It supports multiple network operating systems—NetWare, VINES, LAN Manager, and LANtastic—and both Windows and DOS clients. It was one of the fastest performers here. But dial-out capability must be added, and the package's management features can stand improvement.

Remote Office is licensed by client, which could add up if you've got more than a few users: \$695 for a 2-port version for hardware and software, \$2,195 for 8 ports, \$3,995 for 16 ports, and \$5,995 for 32 ports; or \$395 for software only for 2 users. For additional users over the number of licensed ports, you need to purchase client software, at \$69 for 1 client, \$249 for 5 clients, \$359 for 10, and \$859 for 25. For dial-out capability, you must purchase MNP2 from Network Products for \$49 per modem.

Installation was simple, even for an

▶ FACT FILE

Remote Office, Version 1.2

List price: Software for 2 users, \$395, Software for 2 users and 2-port DigiBoard 2E serial communications board, \$695, software for 4 ports and DigiBoard 4E serial communications board, \$1,295, software pack for 1 client, \$69, software pack for 5 clients, \$249

In short: Remote Office, Version 1.2, supports a wide range of network operating systems—LAN Manager, LANtastic, NetWare and VINES—and both Windows and DOS clients. It offers good security features and is also easy to install and to use. Although it performed well on our tests, Remote Office needs better management facilities.

Stampede Technologies Inc., 78 Marco Ln., Dayton, OH 45458, 800-763-3423, 513-291-5035, fax, 513-291-5040, 514 on reader service card

SUITABILITY TO TASK		
Installation and configuration		GOOD
Management		FAIR
Dial-in		GOOD
Dial-out/LAN-to-LAN		POOR

Remote-Node Servers

inexperienced user. Outside of a few confusing moments because of out-of-date documentation, installation and configuration of the product were a cinch. Remote Office consists of the host portion and a client portion. The Remote Office host can run on a nondedicated PC, but it is generally a good idea



Remote Office is reliable, easy to use, and a fast performer for remote-node access. In addition, it can run on a nondedicated PC.

not to do any day-to-day, end-user processing on a communications server.

Both client and host PCs are configured and maintained with the interactive RO Utility. Once the host is installed, it's easy to set up new users. At user setup you can specify the maximum connect time and how long the user can remain inactive before being timed out. Users cannot be restricted to specific ports.

The client is used to define and later connect to a list of Remote Office hosts. You can use the client in command-line mode. (A Windows version is also available.) This makes it easy to write small batch files for quick dial-up and log-on to a specific server, and to handle log-off and disconnect simply.

Stampede also did a terrific job on security. The package validates all user names and passwords against an encrypted access-control file before access to the network OS's log-on and security process is granted. This additional layer of security is further enhanced by two call-back options and support for caller ID. Since Remote Office uses PPP between the clients and the server, it is able to use Challenge Handshake Authorization Protocol (CHAP) for encrypted password authorization.

All configuration and management in-

formation is kept on the host PC. On a peer-to-peer network the Remote Office control information can be stored in a shared directory and administered from another PC on the LAN.

Remote Office keeps a variety of user-activity statistics. The report details log-on and log-off events but can only be sorted by date. The Bindery report lists users and tells you if they are found in NetWare's Bindery and in the Remote Office users file. The only way to get detailed usage statistics for a specific user or a specific report is through a user or port-detail screen.

Remote Office is reliable and easy to use, and it performed well. It's not the all-in-one-package solution offered by some others here, but that will recommend it for some networking situations.

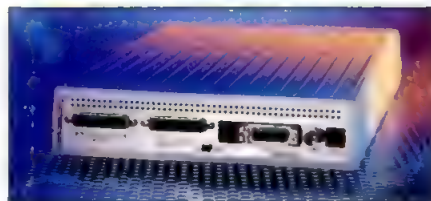
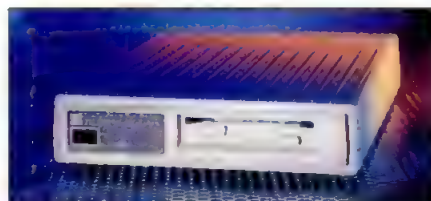
Telebit Corp.

NetBlazer PN4

BY J. C. LOVE

Telebit Corp.'s NetBlazer PN4 is priced pretty well, at \$2,999 for a four-port version (\$3,699 with a hub), includes unlimited client software, and is one of the most easily configured remote-node servers we tested. The user interface is outstanding, and the Windows setup program gets you up and running quickly.

Still, it can stand some improvements. It does support both IPX and TCP/IP, but there is no installation program for the client, and if you want the NetBlazer to support dial-out for IPX, you need the ACS Option, which is a separate purchase. (Support for dial-out under



With Telebit's NetBlazer, modem configuration is automatic, which helps simplify installation and configuration.

FACT FILE

NetBlazer PN4

List price: With 4 ports, \$2,999, with 4 ports and hub, \$3,699, unlimited license for client software included in unit price. **In short:** The NetBlazer PN4 seems something of a remote-node server in progress. It offers a good Microsoft Windows installation utility for the server, but the remote-node software was a problem and most other management functions are only available via a Unix-based command-line interface. It is tightly tied with NetWare, but its management features are somewhat lacking. Right now, you have better choices for your remote-node requirements, but stay tuned to this Telebit server.

SUITABILITY TO TASK

Installation and configuration	GOOD
Management	FAIR
Dial-in	FAIR
Dial-out/LAN-to-LAN	FAIR

515 on reader service card

TCP/IP and AppleTalk is standard.) In addition, it does not have the flexibility to dial multiple numbers.

The \$179 ACS Option is needed to support both modem pooling from IPX workstations and remote-control software such as pcAnywhere or Carbon Copy (which must also be purchased separately).

Installing the four-port version of the NetBlazer was not a problem. The unit can boot up from its floppy disk, or it can be configured to boot up from the network. You can connect up to four modems.

The NetBlazer's automatic modem configuration, which works as long as your modem is in the included MODEM-CAP.TXT file, is a big plus. Most modems on the market are on Telebit's supported list, but if yours is not, Telebit tech support will work with you to create an entry. The NetBlazer intimately manages its connected modems by sensing more of the RS-232 electrical connections than are commonly used.

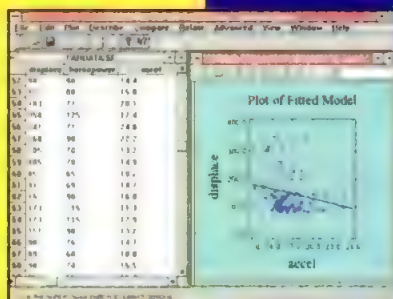
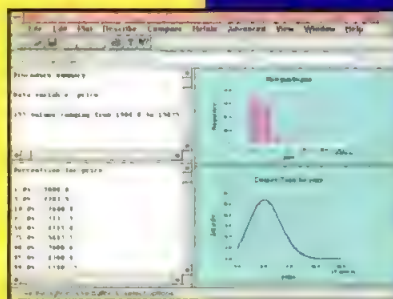
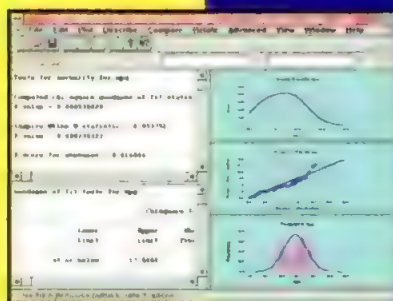
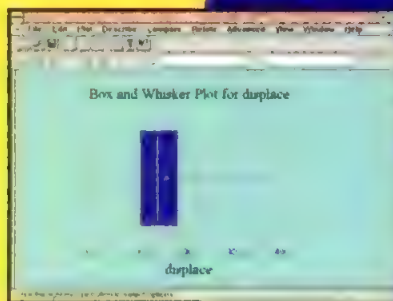
The QuickStart Windows program can use a direct terminal connection between your PC's serial port and the NetBlazer's first 25-pin D connector. Telebit also allows you to configure via your NetWare network, unlike products such as NEC's Dr. BonD-S, which requires you to establish an IP telnet session to configure across your network.

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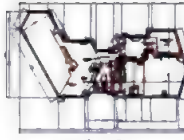
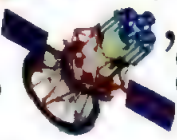
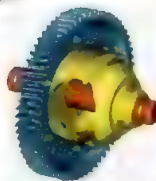
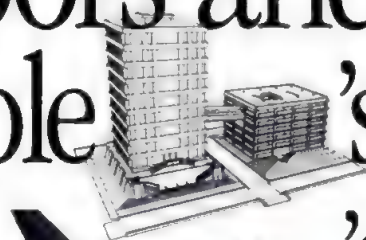
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The remote-node software installation turned out to be daunting, although once installed, it can run in a Windows or DOS environment. The lack of a remote-node client installation program, however, requires you to be closely familiar with NetWare's IPX or ODI shell files.

The recommended configuration includes a TSR watch utility that guards your remote users from downloading large files across the asynchronous link, including attempts to execute file-server resident programs.

Under Windows, the TSR watch program will pop up a full-screen DOS box to display its message if you are not already working in a DOS box. A configurable lack-of-activity time-out, for example, defaults to 6 minutes, and automatically tears down the phone connection while the NetBlazer spoofs the server. Any remote-node activity affecting a network resource will instigate a reconnect. The NetBlazer keeps a log in its RAM of all events including log-ons and log-offs by user.

The NetBlazer has some strong points—a great user interface and quick installation and configuration time. Once the NetBlazer's drawbacks are addressed, such as the lack of both a client installation program and dial-out support for IPX, it will be a very attractive product for this market. Fortunately, it doesn't have far to go.

3Com Corp.

• AccessBuilder

SHAWN F. KAFIPOUR

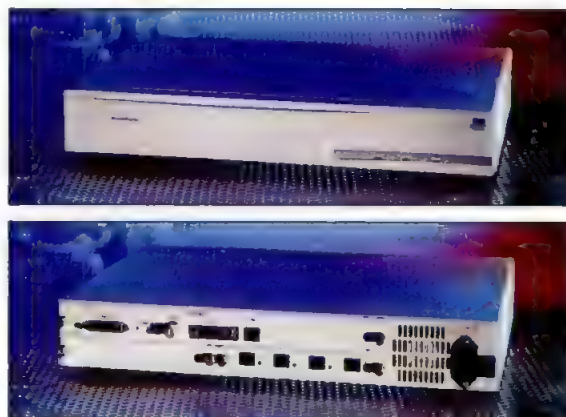
If you are looking for a robust, scalable, multiprotocol remote-access server that is relatively easy to install and configure, consider 3Com Corp.'s AccessBuilder. Designed for speedy installation in NetWare environments—even for novices to the world of remote computing, it costs \$3,495 for the four-port Ethernet version and \$4,495 for Token-Ring.

The AccessBuilder is IPX-enabled by default, which simplifies configuration for NetWare users. It also supports AppleTalk, DECnet, IP, NetBIOS, and VINES protocols. But it does not include dial-out modem pooling, and the interface is command-line driven (3Com says the next release will be Windows-based).

The AccessBuilder Ethernet module supports AUI, BNC, and 10BaseT cable. The appropriate connector, however, must be selected by a toggle switch. It has two slots that are dedicated for asynchronous cards—available in either 4- or 8-port versions, for a maximum of 16 asynchronous ports—to help you accommodate emerging nomads. As an added bonus, the AccessBuilder can be equipped with a single-port synchronous card to provide access to another remote LAN.

The AccessBuilder has a resident SNMP agent, which allows a network manager to perform all configuration, management, and auditing functions from any SNMP-compatible management platform. You can customize it to enhance performance in your environment with features such as static routing and filtering. On the downside, if you are not planning on SNMP, no other in-band monitoring, such as telnet, is available. You'll have to suffer through out-of-band management by connecting a dumb terminal or a terminal emulation software to the AccessBuilder's RS-232 port.

The AccessBuilder includes good security features, such as password protec-



The AccessBuilder has clearly labeled connections to help you get up and running. As an added bonus, the AccessBuilder can be equipped with a single-port synchronous card to provide access to another remote LAN.

tion and automatic call-back. Its resource access manager insulates specific network segments and reports all unauthorized attempts to the management station. In addition, the AccessBuilder can be configured on a per-port basis for routing, bridging, or ARA (for AppleTalk users).

Installing the client software was simple. The log-on and log-off procedures are automatically created by the program. The AccessBuilder client software provides both Windows and DOS utilities for basic network connections and statistics reporting. The lack of dial-out capability is a drawback. The client software, which is included with an unlimited license, supports Windows, Windows for Workgroups, DOS, and Macintosh.

On the server side, the front-panel LEDs are primitive and provide little diagnostic help. The AccessBuilder's operating software includes some useful diagnostic tools, such as Ethernet statistics and connection verification, to help isolate both local and remote problems.

Each port on the AccessBuilder performs both MAC and protocol header compression together with a proprietary data compression to maximize dial-up throughput. It shows: 3Com's product turned in some good performance numbers in our testing.

If you don't mind the command-line interface and plan to implement SNMP management, 3Com's AccessBuilder is a solid solution for both newcomers to remote access and router experts. □

▶ FACT FILE

AccessBuilder

List price: With 4 ports and Ethernet support, \$3,495; with 16 ports and Ethernet support, \$6,295; unit price includes unlimited license for client software

In short: With its good security, ease of installation, and reliability, the AccessBuilder is a good choice for remote access. It is a robust and expandable multiprotocol product that includes a good set of security features. The AccessBuilder is also SNMP-compatible, although it lacks other in-band management features and suffers somewhat from a less than desirable command-line interface.

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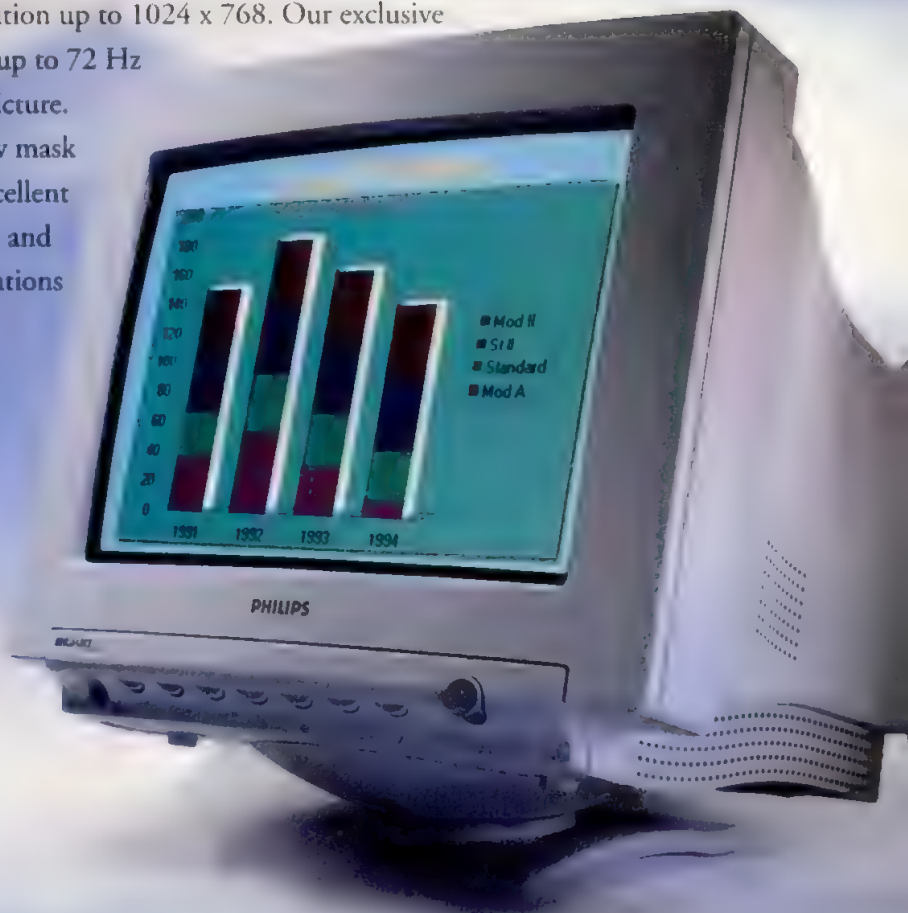
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V I S U A L B A S I C

Snap-On Tools

Powerful add-ons for Visual Basic let you concentrate on perfecting your own code—not on reinventing the wheel.

By Sheryl Canter & Stephen W. Plain

Microsoft Visual Basic's often-copied visual design model is probably the definitive secret of its early success. But another feature—its open custom-control architecture—has proved crucial in making it one of today's biggest development tools for Microsoft Windows applications.

Microsoft Visual Basic (VB) is extensible through custom controls: prebuilt program components that can be dropped seamlessly into the VB development environment and incorporated into applications. This lets developers solve common programming tasks using prewritten routines, freeing the developers to concentrate on the demands of their own applications.

A basic set of controls ships with Microsoft Visual Basic for Windows, Version 3.0, Professional Edition, but innovative developers have created hundreds more. The result is a huge aftermarket of third-party custom controls and other add-ons—



collectively dubbed VBXs after the file extension they share.

THE REVIEW LINEUP

Add-ons for VB come in so many figurative shapes and sizes that categorizing them for this story was a hefty challenge. After surveying the market, we identified four broad groupings we felt would be of

VB Controls: *The Next Generation*

By Sheryl Canter

One of the best things about Microsoft Visual Basic—its open architecture—was added as an afterthought. When the Microsoft VB team of developers showed their new product to Bill Gates, his response was, "Okay, but make it extensible." So back they went to add the custom control architecture, which lets you incorporate prebuilt components called "custom controls" into VB applications.

No one realized at the time how popular custom controls would become. And no one foresaw that their inherently 16-bit characteristics would become a problem down the road. Today, with Microsoft Windows NT a reality and Chicago looming on the horizon, VB must go 32-bit or there won't be a version of Microsoft's most popular development tool for Microsoft's most strategic operating systems.

The solution is a new custom control

architecture based on Microsoft OLE 2.0 that can be compiled as either a 16-bit or 32-bit object. Today's 16-bit custom controls are called VBXs (for Visual Basic Extensions), after their file type. The new OLE-based controls will be called OCXs.

CIRCUMVENTING LIMITATIONS

In addition to being inherently 16-bit, VBXs have a number of other limitations. They are tightly bound to VB as a container, relying on the Microsoft Windows messaging system, with some proprietary additions. Their reliance on 16-bit Windows 3.1 restricts them to Intel machines.

There are also some limitations in what they can do. They can't perform callbacks; that is, they can't make function calls to the container program that called them. Also, third-party VBXs are limited to a standard set of methods; there is no direct way to add custom methods for a particular control. The

awkward work-around that developers use is to set up a Property to act as a flag to call functions within the VBX.

OCXs will circumvent all these limitations and also add some additional capabilities by virtue of their OLE 2.0 foundation. They can take advantage of OLE 2.0 features such as in-place editing and automation. Also, because they use the standard OLE 2.0 interface, they can be used in a limited fashion in any OLE 2.0 container, including Microsoft Word 6.0 and Microsoft Excel 5.0. (Event-based code won't work because only Properties and Methods are part of the OLE 2.0 standard; event support is an OCX enhancement.)

Another advantage of OCXs is a less technical one: Since OLE 2.0 DLLs will ship as part of Chicago and all future Microsoft operating systems, developers won't have to ship huge runtime DLLs along with their VB programs.

primary interest to corporate developers: data-aware controls; grid controls; utilities and enhancements; and graphics and multimedia.

We then sifted through some 40 products in these four categories and selected four from each category to review. Those products not reviewed, many of which will be interesting for specialized tasks, are briefly described in chart form ("VBXs: The Short List").

Inevitably, many interesting products, even entire categories of products, go unmentioned. With over 270 VB add-on products at last count, many of which include multiple controls or .DLLs, we couldn't come close to covering the entire spectrum of available add-ons.

NEW DIRECTIONS

VB is not the only environment that can take advantage of VB controls. Among C++ tools, Borland C++, Version 4.0, Microsoft Visual C++, Version 1.5, and Symantec C++ Professional, Version 6.1, also let you incorporate VBX controls in your programs. At press time, Borland was also airing plans for a new visual development tool not based on the C language, which will be able to utilize VB custom controls.

In the longer term, bigger changes

are in store. Today, VB and its add-on products are all inherently 16-bit. As Windows becomes a true 32-bit operating system, VB and its custom control format will inevitably follow suit. Microsoft has already announced details of the new 32-bit VB control specification, which will be based on the open Microsoft OLE 2.0 standard (for details, see the sidebar "VB Controls: The Next Generation"). All of these developments promise to increase the number of available controls and extend the number of development platforms on which you can use them.

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DATA-ACCESS CONTROLS

As soon as Microsoft added its Access database engine to Release 3.0 of VB, vendors raced to make their controls

ROOM FOR THIRD-PARTIES

The requirements for creating a VBX are published in Microsoft's Control Development Kit (CDK), but the specification for creating a VBX container—a tool that can take advantage of VBXs—is not published. A few vendors (notably Borland International) have figured out how to provide support for VBXs in their own development products, but doing so requires a tremendous amount of work.

In contrast, OLE 2.0 is an open standard, and its messaging interface is published in detail. One of the more interesting consequences of the transition from VBXs to OCXs is the opportunity for third-party vendors to create competitors to VB itself. This will cause the market for custom controls to expand significantly—good news for software vendors as well as VB users.

FUTURE TOOLS

VBXs will still be supported in the 16-bit versions of Microsoft Visual Basic and Microsoft Visual C++, but OCXs

will work with all versions of VB, including Microsoft Visual Basic for Applications, the company's new common macro language. The first development tool to support OCXs will be Microsoft Access 2.0, which will be shipping by the time you read this.

Microsoft will begin selling an OLE Custom Control Development Kit (OLE CDK) shortly after the release of Visual C++ 2.0 in mid-1994. The OLE CDK will contain tools for creating both 16- and 32-bit OCXs. It will also include add-ons to Visual C++ in the form of extensions to the MFC (Microsoft Foundation Classes) and two new Wizards for generating the MFC code. Microsoft will also offer a porting tool that will be able to create an OCX prototype from VBX source code.

By adding capabilities and enlarging the market, the new OCX standard should cause an expansion in the types of custom controls developed and sold by third parties. It's another boost for an already thriving segment of the market. □

“data aware”—that is, capable of binding to VB's Data Control. Today, there are data-bound controls in virtually all of our four categories, even graphics. In this story, we review data-bound controls whose chief design goal is to ease database development. Even with this narrow definition, there are plenty of products from which to choose since only a handful of the standard VB controls are data aware, even in the Professional Edition.

The data-bound products we review are Crystal Reports, Professional Edition, Version 3.0, from Crystal Services; Integra VDB, Version 2.0, from Coromandel Industries; Q+E MultiLink/VB, Version 2.0, from Intersolv; and WinWidgets 2.01, Visual Basic Edition, from Simple Software.

MultiLink/VB and Integra VDB are competing products that both offer strategies for making it easier to use VB as a database front-end. Each comes with a multitude of drivers for different database

formats and adds features and functionality of special interest to database front-end developers. Integra VDB includes a standalone SQL database engine for development and deployment of client/server applications.

Microsoft Visual Basic, Professional Edition, ships with a scaled-down version of the Crystal Reports report writer for use in database front-ends. Crystal Reports Pro 3.0, reviewed here, is a substantially enhanced version with new features such as a data-aware grid control and broad, native-SQL database access capability. WinWidgets is a collection of interface controls, many of which are data bound. Of special interest is its data-bound grid control, which offers data validation features.

Our Contributors: SHERYL CANTER is a contributing editor of *PC Magazine*. RICHARD V. DRAGAN is a programmer, and DAN SMITH is a Technical Analyst at *PC Magazine*. STEPHEN W. PLAIN is a frequent contributor to *PC Magazine*. THOMAS MACE was the associate editor in charge of this story, and JAY MUNRO was the project leader.

BUILDING BETTER GRIDS

Although most grid controls are data aware, we put grid controls in a separate category because they are used for many tasks besides database front-end development. One of the most obvious uses is adding spreadsheet functionality to your applications. In this category we review Borland Visual Solutions Pack; Data Widgets, Version 1.0, from Sheridan Software Systems; Spread/VBX, Version 2.1, from FarPoint Technologies; and TrueGrid Pro, Version 2.1, from Apex Software.

Spread/VBX and TrueGrid Pro are essentially spreadsheet programs packaged as VB custom controls. They are direct competitors, and each has a large following. A new entry into this fray, VisualTools' Formula One, Version 1.0, missed our original review cut-off date, but is included on the accompanying chart. The state-of-the-art package offers a fully functional spreadsheet (126 functions) that can read and write the Microsoft Excel file format.

Data Widgets and Borland Visual Solutions are collections of controls. All the controls in the Data Widgets package are data aware, but the most powerful of them is the grid control, which virtually duplicates the grid object in Microsoft Access. The Borland collection also includes a grid among its various components, and offers a cost-effective way to add spreadsheet functionality to your application.

VB UTILITIES

One of the biggest areas we cover resists narrow categorization: those collections of tools, libraries, and utilities that can help you overcome diverse programming hurdles. The four products we chose to review from this wide-open field were QuickPak Professional for Windows, Version 3.2, from Crescent Software; SpyWorks-VB, Version 2.0, from Desaware; VBAssist, Version 3.0, from Sheridan Software Systems; and VB/Magic Controls, Version 1.54, from

HIGHLIGHTS

VB Add-Ons

AN OPEN ARCHITECTURE is key to Microsoft Visual Basic's huge success as a professional Windows development tool. Third-party custom controls plug into the VB development environment—and into your apps. Before you tackle a generic programming task, check to see if a custom-control vendor has already done the job.

DATABASE DEVELOPERS get a huge boost from custom controls. By augmenting VB's limited data-access

abilities with data-bound third-party tools, you can create powerful front ends for transaction processing without extensive coding. Query and reporting applications are far easier to build, and you can present your users with an intuitive WYSIWYG interface for formatting complex reports. Also available are extensive driver libraries for native SQL connectivity.

GRAPHICS support is a weak link in VB but add-ons change the picture.

Tools are available that cover everything from image-format conversions to the addition of scanner support to your applications.

NEW 32-BIT CONTROLS are on the way as Windows evolves toward a fully 32-bit operating system. Microsoft has already outlined plans for OCX, a 32-bit successor format to today's VBX controls. OCXs will be based on OLE 2.0 and will work in many environments besides VB.

AJS Publishing.

QuickPak Pro includes a collection of VB controls and a library of low-level assembly language routines for tasks such as accessing DOS file functions and performing string manipulations. It also includes a hypertext-like facility for creating on-line help. Many of the controls are enhanced replacements for standard VB custom controls. For example, the command buttons support bitmapped images and shading options, and the Caption control can be attached to a TextBox and then manipulated as a single unit. QuickPak Pro also offers a number of controls that VB lacks entirely, such as a calendar and a spin button.

VB/Magic is a standalone visual editor that lets you design your own interface controls including command buttons, slider controls, toolbars, tool palettes, dialog boxes, and pop-up menus. Finished controls are saved as resource files for incorporation into your VB application. This product lets you create such interface objects as fly-out buttons that are not available elsewhere.

VBAssist and SpyWorks-VB differ from other reviewed products in that they are utilities rather than controls. VBAssist lets you access standard VB functions more easily by adding a speedbar and a second toolbox with shortcuts. For example, you can change the tab order in a database front end by simply pointing and clicking, rather than tediously editing each field's Tab Property.

SpyWorks-VB gives you access to

powerful—and potentially dangerous—parts of Windows that you could not access otherwise. You can spy on previously invisible Windows messages, employ systemwide hooks, and make callbacks to the Windows API. This product's power is for experienced programmers only. In fact, Desaware boasts that it is easier to crash Windows with SpyWorks-VB than with any other add-on.

GRAPHICS CONTROLS

The graphics controls that come bundled with VB are actually quite primitive. The Picture Box and Image controls can read and write only three formats: .BMP, .DIB, and .WMF. To access other formats, such as .PCX or .TIF, you'll need a third-party add-on. VB offers the Graph control for business graphics, but there are no controls to manipulate images or perform other advanced graphics functions such as resizing, rotation, sharpening, or smoothing.

The graphics controls we review are FXTools/VB, Version 1.4, from ImageFX; Graphic Server SDK, Version 2.5, from Pinnacle Publishing; ImageKnife/VBX, Version 1.3, Professional Pack, from Media Architects; and ImageStream/VB, Version 1.01, from VisualTools.

ImageKnife and ImageStream, both

replacements for the standard VB Picture Box control, offer image-processing functions and enhanced file format support. ImageStream has the broadest format support, licensing image filters from the company that develops them. But its image-processing features are relatively weak, and you must pay royalties if you sell more than 100 copies of your app.

ImageKnife supports most popular formats, though its format support is not nearly as extensive as ImageStream's. ImageKnife is far stronger, however, in its image-processing features—especially palette manipulation.

Graphic Server SDK is an enhanced version of the Graph-

ic Server that comes bundled with VB Professional. This version offers full documentation for the Graphic Server API and an enhanced version of the ChartBuilder control that, among other things, lets you print multiple graphs on a page.

FXTools/VB is in a class by itself. This inexpensive special-effects package lets you add drama to your VB applications and presentations with wipes, fades, and other visual tricks. It includes four custom controls, three of which are replacements for standard VB controls. The fourth is a Rotating Text control which, like the

SpyWorks-VB gives you access to powerful—and potentially dangerous—parts of Windows that you could not access otherwise.



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other three, supports dozens of different special effects.

No matter what kind of Windows application you are building with Microsoft Visual Basic, chances are you can find a custom control that will shorten

your development time and make the job easier. The reviews that follow will give you a feel for what's available in the four categories of custom controls we've covered and should help you make an informed choice.



Data-Aware Controls

Crystal Services Inc.

• Crystal Reports, Professional Edition

BY STEPHEN W. PLAIN

If you use Microsoft Visual Basic 3.0, Professional Edition, you're probably familiar with Crystal Reports for Visual Basic—the bundled reporting tool that makes up for the lack of a reporting capability in the core VB product. Crystal Reports, Professional Edition, Version 3.0, is a substantially beefed up release of the bundled tool, offering plenty of value for \$395. An upgrade for licensed VB 3.0 users is available for \$199.

Crystal Reports Pro is compatible with Microsoft Access, Excel, and FoxPro; Btrieve, Clipper, dBase, Paradox (up to version 4.5), and Paradox for Windows files. It also offers native support for the leading SQL databases as well as ODBC (Open Database Connectivity). The well-thought-out design lets you use Crystal Reports Pro in several different ways.

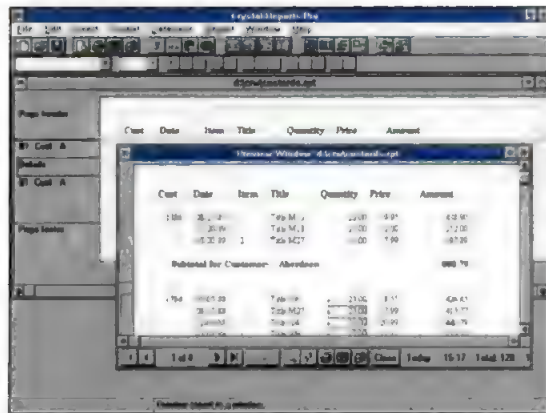
With the WYSIWYG Report Designer, you can create report formats and save them either as .RPT files or standalone .EXE files. You can then call the included DLL-based print engine from any programming language that supports DLL calls; the engine lets you produce reports from prebuilt .RPT files and customize characteristics (such as selection formula and sort orders) at runtime.

Also included are two custom con-

trols that let the developer place reports on a VB form: the Crystal Custom Control and the impressive TrueGrid 2.0, Standard Edition, control from Apex Software, a fully functional, updateable grid control that's worth having in and of itself.

COMPLEX REPORTS

The Crystal Reports Designer uses a multiple document interface to provide a robust, intuitive tool for "painting" reports. You can define reports as free-form, cross-tab, or as mailing labels, while the visual representation makes creating these often-complex reports much more concrete. To create a stan-



The preview window in Crystal Reports, Professional Edition, can be accessed from the Designer as well as from within a VB project.

dard free-form report, simply drag field names from the list of available fields and drop them in place. You can format fields and sections smoothly using the program's toolbar or the right mouse button, and you can place lines, boxes, bitmaps, and OLE objects anywhere in the report.

Crystal Reports Pro supports OLE 2.0

as a container application, which means OLE objects can be embedded in the report and edited in place.

The Crystal Custom Control is similar to the one supplied with VB, but this enhanced version lets you bind it to an .RPT file, a VB data control, the data-field property of all controls bound to a particular data control, or a TrueGrid control.

When a Crystal Reports Pro control is bound to a data control, you get a basic columnar report of the data. Various properties of the Crystal control let you modify some aspects of the report, such as header and footer titles, window sizes, and record-selection criteria. When you bind a Crystal Reports Pro control to a TrueGrid control, the report inherits the characteristics of the grid, including the column and row sizes, headings, and grid-line settings. As with all Crystal Reports Pro reports, bound reports can be sent to a preview window to be browsed before printing.

Unfortunately, Crystal Custom Control does not offer nearly as many features as the print engine DLL, and the properties do not correspond directly to the DLL's function calls. Still, if your VB applications rely on reporting, and especially if they are client/server apps, you should consider upgrading to this premier reporting tool.

► **Crystal Reports, Professional Edition, Version 3.0.** Crystal Services Inc., 1050 W. Pender St., #2200, Vancouver, British Columbia, Canada V6E 3S7; 800-663-1244, 604-681-3435.

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Coromandel Industries Inc.

• Integra VDB

BY STEPHEN W. PLAIN

More and more, Microsoft Visual Basic is emerging as a serious tool for developing client/server applications. Version 2.0 of Integra VDB, from Coromandel Industries, automates the process of creating database forms and comes with its own standalone SQL engine that can be used for client/server development or royalty-free deployment. Integra VDB makes creating database forms (especially master/detail forms) a breeze, and 2.0 adds more flex-

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ibility. The product is available as a \$199 desktop version, which provides support through Microsoft's ODBC desktop drivers for dBASE, Btrieve, FoxPro, Access, and Paradox; and a \$599 client/server version that includes the above plus ODBC access to all compliant SQL back ends.

Integra VDB has five elements: architecture custom controls (Applications, Data Sources, Form Definitions, Form Builder, and Queries), visual custom controls, the ANSI SQL-92-compliant Integra SQL engine, a data manager program, and a high-level call interface to ODBC. There are nine visual controls that are bound to queries; these include a grid control, regular and masked text boxes, check boxes, combo boxes, and others.

To create a database form, you first double-click on the Form Builder control in the toolbox. This starts a series of dialog boxes that guide you through the process of defining your application. The result is a form that gives you visual controls for your data, along with command buttons for each required database operation. To make the form a fully functional application, you only need to give the data source control the connection string information for your database and place some startup code in the Form_Load event.

The one drawback to Integra VDB is that you cannot edit an existing database form as easily as you can create one, since you can't go back through the same dialogs. Still, Integra VDB is a helpful development tool.

► **Integra VDB, Version 2.0.** Coromandel Industries Inc., 70-15 Austin St., 3rd fl., Forest Hills, NY 11375; 800-535-3267, 718-793-7963; fax, 718-793-9710.

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Intersolv Inc.

● Q+E MultiLink/VB

BY STEPHEN W. PLAIN

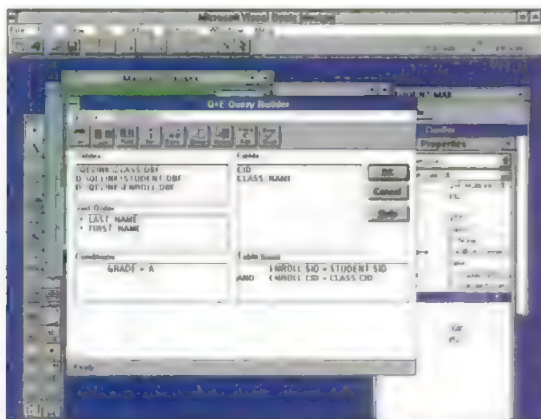
Q+E MultiLink/VB, from Intersolv (which recently acquired Q+E Software), provides broad database connectivity and a set of well-implemented data-bound custom controls. Version 2.0 significantly improves upon VB's native database connectivity, and its flexible and uncluttered

approach will help you cut development time. The \$199 package offers access to two dozen databases, including most SQL back-ends.

MultiLink/VB also provides a QE-LINK.VBX file that adds 12 custom controls to VB's toolbox. Most of these are enhanced versions of VB's standard interface controls.

POWERFUL CONTROLS

The Connect control is used to represent each distinct database source you want to connect to. The Query controls represent a query associated with one or more



The Query Builder in Q+E MultiLink/VB lets you select tables, joins, sort orders, and fields using its well-designed point-and-click interface.

Connect controls, while the Grid supplies the interface to the user. You must place on a form one Connect control for each database driver you wish to access; you can then add Query controls to access it. After that, the additional data-bound controls can be quickly placed and associated with a Query control. MultiLink/VB provides enhanced data-bound versions of the text box, check box, combo box, command button, list box, picture box, radio button, and scroll bar controls.

When you set the properties of a Query control, you get a taste of what has made the company's SQL access product, Q+E Database Editor, so popular. Clicking on the ellipsis for the pTables property of the Query control starts you through a guided process of selecting tables, joins, sort orders, and fields using Q+E's point-and-click dialogs. This is a quick and powerful way to build syntactically correct SQL statements. If you need to update

records or perform heterogeneous queries, you will probably opt to use related single-table queries, a method that adds a little coding to this mostly code-free product.

Controls that are dependent on a Query control are associated with it using the pQueryName property and do a good job of assuming the characteristics you will want. For instance, creating a control array using the DB Text Box control will automatically cause each box in the control array to contain a separate record from the query. By aligning them vertically and placing a vertical DB Scroll Bar control next to them, you instantly have a scrollable multiple-record table. The Query Grid control offers a simple way to provide a browsable spreadsheet of data, but it lacks some of the flexibility of VB's standard grid control. Some properties are missing that would otherwise let you define the number of fixed columns, customize grid lines, and vary cell-border styles.

You're likely to find that the DB Command Button and DB Radio Button Group controls are very useful, however. The DB Command Button has a property called pFunction that can be set to make a click operation perform any one of 22 common database operations, including DoQuery, Next (record), EnterQBE, TranCommit, ExecSQL, and Find. The DB Radio Button group lets you define multiple radio buttons with one control.

MultiLink/VB also includes a database manager program that lets you create and modify dBASE and Paradox tables. As is true throughout the product, however, you can only access Paradox tables if you have that engine installed. The other database that is noticeably absent is Microsoft Access. Despite these few limitations, Q+E MultiLink/VB is an exceptionally powerful product that is both well designed and well documented.

► **Q+E MultiLink/VB, Version 2.0.** Intersolv, 5540 Centerview Dr., #324, Raleigh, NC 27606; 800-876-3101, 919-859-2220; fax, 919-859-9334.

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Simple Software Inc.

• WinWidgets, Visual Basic Edition

BY STEPHEN W. PLAIN

Simple Software's WinWidgets 2.01, Visual Basic Edition, is a mixed bag of tools that provides several useful controls with interesting properties that enhance VB's own data controls. It's not the most robust VB add-on around, but the functionality it offers makes the \$149 package worth your attention.

WinWidgets provides its own version of a command-button control and seven data-bound custom controls: check box, radio button, group buttons, edit control, list box, combo box, and a grid control. All of the controls have a 3-D look and many provide properties that let you play sound files or display bitmapped images when they are clicked.

WinWidgets also offers robust data-validation features. With the edit-box and combo-box controls, you can adjust both DataClass and DataType properties to allow filtered input and formatted output. Some of the available data classes offered are Char, Number, String, Date/Time, Clock, and Mask. The DataType property is used with the Number data class to specify formats like integer, float, short, and long.

Data can be masked using the FormatString property to specify which characters should be numbers, characters, or literals. If you've ever been frustrated by the instability of the masked-edit control included with VB, these controls may solve your problem.

The WinWidgets grid control is also very useful. It supports editing, both in-place and from separate controls, and lets you establish field properties for each column in a grid.

DON'T EXPECT POLISH

While the Visual Basic Edition is meant for VB programmers only, there is some annoying overlap with the C++ version of WinWidgets. For instance, several "static" controls are added automatically to the VB toolbox that essentially mimic other standard VB controls. These are included to give C programmers access to VB-like functionality and

should be ignored by VB developers. Similar irrelevant features are noticeable in the documentation, which comes only in an on-line format. But despite some rough edges, WinWidgets, Visual Basic Edition, solves some specific problems

VB programmers often face.

► **WinWidgets 2.01, Visual Basic Edition.** Simple Software Inc., 543 Third St., Brooklyn, NY 11215; 800-653-3234, 718-965-1741; fax, 718-965-1740.

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Grid Controls

Borland International Inc.

• Borland Visual Solutions Pack

BY STEPHEN W. PLAIN

The Borland Visual Solutions Pack is an attractive grab bag of third-party custom controls that is well worth its low price of \$99.95. And as we went to press, Borland was readying an update that promises more features at the same price.

The product's centerpiece is its Spreadsheet Control, created by FarPoint Technologies. This tool provides a bare-bones spreadsheet interface you can distribute with your applications. Unlike most spreadsheet controls, it cannot be bound to data controls, but it does provide a look and feel consistent with that of Microsoft Excel and Quattro Pro. Its 66 properties give you enough control over the grid's behavior for it to serve as a basic spreadsheet module.

Cells within the spreadsheet can be defined as Float, Edit, Static Text, and Picture. By attaching the many formatting properties to menus (such as TypeFloatMoney, TypeFloatDecimalPlaces and TypeTextWordWrap), you can easily emulate a real spreadsheet program. An Action property with 28 different settings can be used to insert and delete columns as well as select and deselect ranges of cells.

Borland Visual Solutions also includes a version of Coromandel Industries' Integra VDB, providing a way to build database forms and queries (see the review in this article). Other controls included in this smorgasbord of VBXs are a Notebook Tab control, a basic word processor, a 3-D chart control, a communications control, an image edi-

tor, and a bunch of gadgets from Micro-Help that provide everything from gauge controls to a deck of cards for use in your home-grown card games.

The new version, which should ship soon after this article appears, is slated to offer 27 custom controls in all. Look for an enhanced spreadsheet control (courtesy of VisualTools Inc.) that corrects the shortcomings of the current offering, a full-featured WYSIWYG word-processor module, and a charting control that offers over 30 chart types.

► **Borland Visual Solutions Pack.** Borland International Inc., 100 Borland Way, Scotts Valley, CA 95066; 800-682-9299, 408-431-1000; fax, 408-439-9262.

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Sheridan Software Systems Inc.

• Data Widgets

BY STEPHEN W. PLAIN

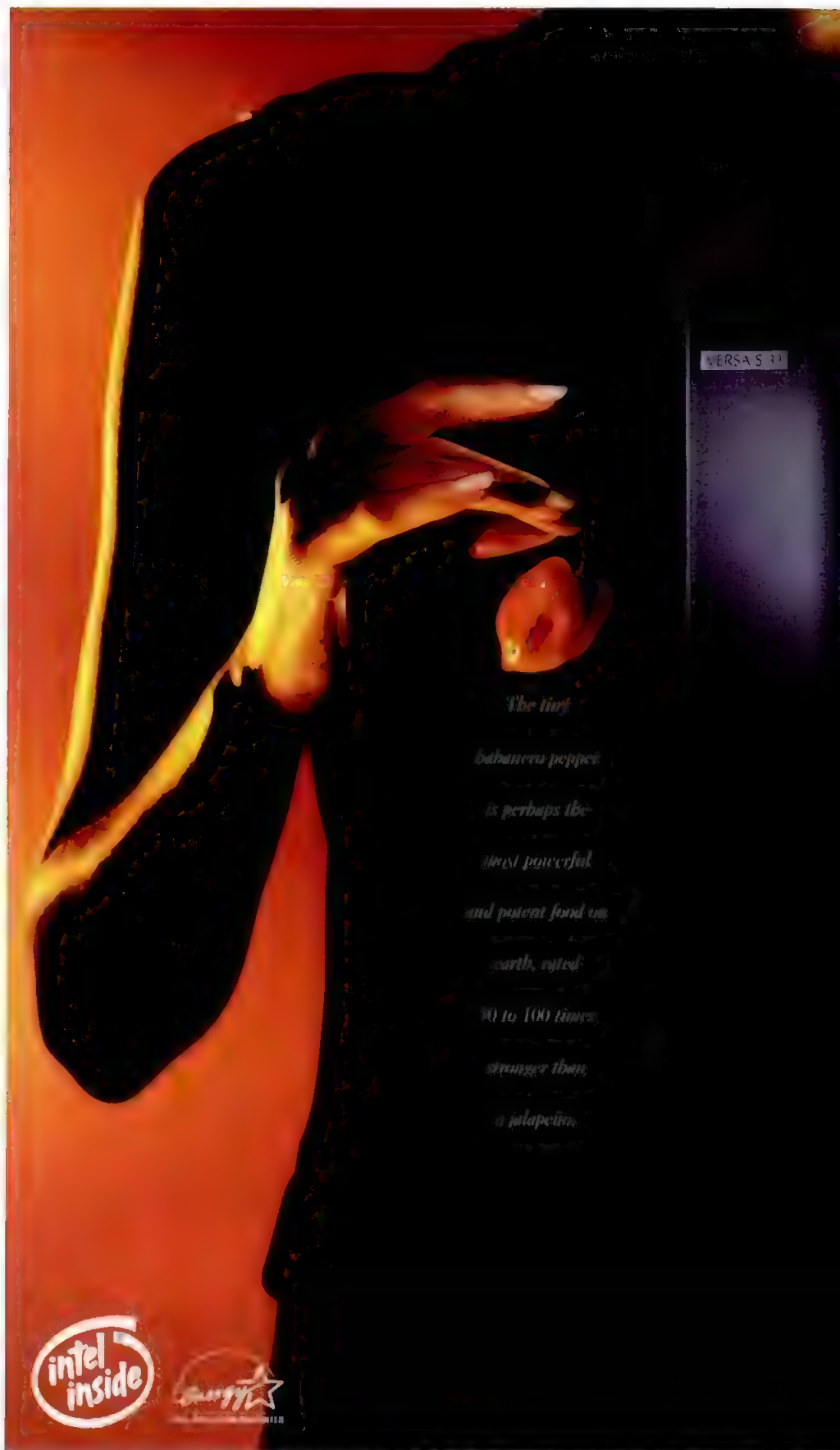
Sheridan Software Systems' Data Widgets, Version 1.0, is a set of six custom controls that substantially improve upon VB's own bound-data controls. Its centerpiece is DataGrid, an enhanced control that spans the middle ground between VB's limited grid control and more expensive, full-featured products like FarPoint Technologies' Spread/VBX.

Data Widgets also includes DataCombo and DataDropDown controls, DataOption and DataCommand buttons, as well as enhanced horizontal and vertical data controls that are more useful than VB's data control. And you get all this for a very reasonable \$129.

THE DATAGRID

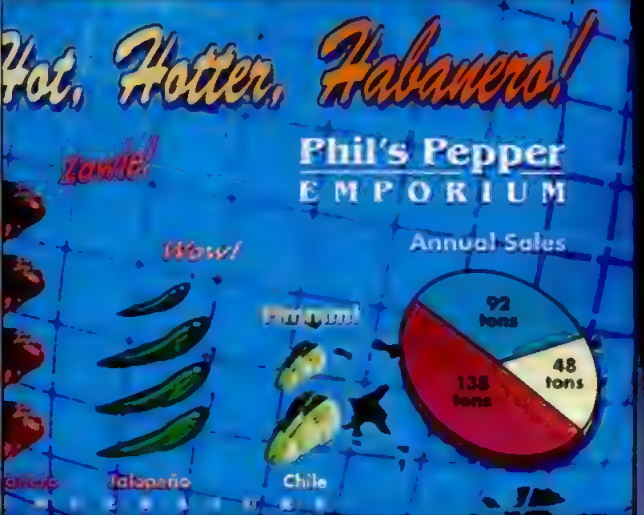
The DataGrid control is geared toward situations where data is logically handled by column. DataGrid has roughly 100

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MORE
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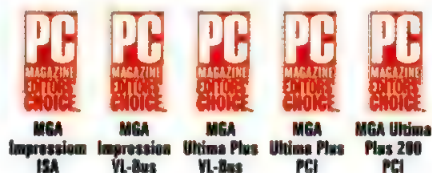
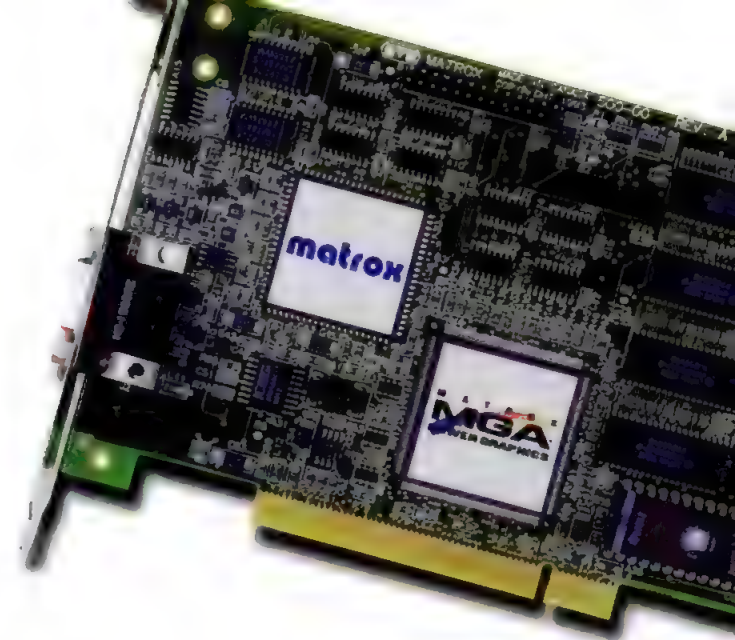
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James Karney, PC Magazine - June 28, 1994

The New Standard in Graphics

"A new graphics standard from Matrox."

Stan Diehl, Byte Magazine - August 1993

64-Bit Performance

"MGA Ultima delivers performance that until recently was found only in graphics workstations."

Jon Pepper, Windows Sources - May 1994



Speed

"Matrox's 64-bit MGA boards are the fastest video accelerators ever to come through our labs. They're Windows speed demons."

Wendy Taylor, PC Computing - August 1993

Matrox MGA Ultima Plus	23.5
ATI Graphics Pro Turbo	22.6
Trident 64	22.6

Taken from PC Magazine's graphics review (June 28, 1994).
WinBench 4.0 @ 1024 x 768 x 24-bit.

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"While its speed alone is reason enough to buy the MGA Ultima accelerator, the board offers excellent color depth support at multiple resolutions."

Jon Pepper, Windows Sources - May 1994

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"At 24-bit color ... , the Matrox card was nearly five times faster than its nearest competitor."

Computer Shopper - May 1994

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Winn L. Rosch, Jonathan Hill, James Karney, Jan Ozer, Lance Ulanoff, Jeff Mace
PC Magazine - June 28, 1994

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Art Liddle, CADalyst - June 1994

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Winn L. Rosch, PC Computing - January 1994

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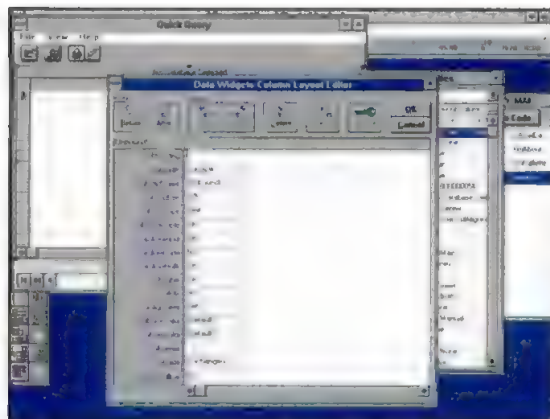
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WinBench 4.0 scores based on 4 MB PCI boards using a Pentium®P-60, 16 MB RAM, 256KB cache.
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matrox

properties, most of which are self-explanatory. By double-clicking on the Column Layout property, you can bring up the Column Layout Editor to set the type of data, formatting, color, and other



Data Widgets' Column Layout Editor gives you a column-based configuration screen where you can set data type, formatting, and other attributes for each column.

attributes for each column, as well as define the field to bind it to when using it with a data control. While this is useful, it does not provide WYSIWYG layout functionality and is strictly column-oriented.

DataGrid supports virtual data access, so you can bind it to even the largest of database tables. It also will detect a single data control on your form and default its DataSource property to that data control automatically.

One of DataGrid's strengths is that it can be bound to a data control on a separate form, an ability other data-bound controls don't offer. Data Widgets gives you two methods. DataGrid has a property called DataSourceHwnd that can accept the handle for the window that contains the data control. You either set it to the enhanced data control's property of the same name at runtime or use a supplied function to obtain the handle of a form containing a standard VB data control.

The other Data Widget controls, too, can be bound to data controls on separate forms. The enhanced data control resembles VB's data control, but it offers an intermediate scroll button for moving pages of data and provides buttons for setting a bookmark at a particular record so a user can return to it in a snap.

Two of the other controls, Data-

Combo and DataDropDown, can be used in conjunction with the grid to provide the user with scrollable selections. DataCombo is a combination edit box/list box that can be bound to a field in DataGrid but can list data from another table. DataCombo can also be used as a lookup validation to ensure that a user-entered value corresponds to one in its list. DataDropDown presents the user with a non-editable scrollable list.

DataGrid is easy to use but suffers from a few weaknesses. While it lets you control color and font-style properties like bold and italic by cell, you can still only use a single typeface for the entire grid. And since DataGrid was designed to mimic the grid in Microsoft Access, all rows change in size

when you adjust one row. Nor can you place check boxes and option buttons within cells in order to create a more customized feel to the grid, as you can with other grid controls. You can, however, designate that a button be placed in the cells of a particular column of DataGrid.

With its ability to span forms, ease of use, and low price, Data Widgets is worth a look, especially if all you need is to bind a grid to a database.

► **Data Widgets, Version 1.0.** Sheridan Software Systems Inc., 35 Pinelawn Rd., #206-E, Melville, NY 11747; 516-753-0985; fax, 516-753-3661.

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FarPoint Technologies Inc.

● Spread/VBX

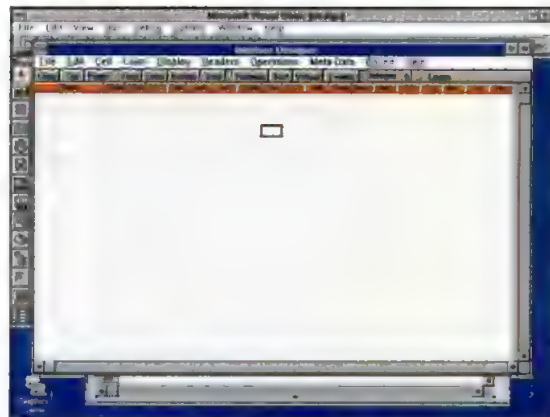
BY STEPHEN W. PLAIN

There are lots of grid controls out there, but FarPoint Technologies' Spread/VBX, Version 2.1, provides over 200 properties and enough functionality to meet even the most demanding of requirements. An update to this \$245 package, due this summer, will sport a new recalc engine, Microsoft Excel compatibility, and busi-

ness graphics such as pie charts and bar graphs.

Spread/VBX can be used as a standalone spreadsheet within your application, or it can be bound to data for use as a database front end. It supports all the databases available through the standard VB data control as well as those accessible through the Q+E Database Library 2.0 using ODBC. Spread/VBX does not let you bind a spreadsheet to a data control on a separate form as Sheridan Software's Data Widgets does, however.

All of the properties, events, and functions available to you with Spread/VBX would be overwhelming if it weren't for the superb Interface Designer layout utility included with the product. This is a standalone .EXE that can be run independently from VB or at design time to customize the properties of a spreadsheet control. What makes the Designer so



The superb Interface Designer used in Spread/VBX lets you format your spreadsheet using live data in a WYSIWYG environment at design time.

helpful is that it uses a real live spreadsheet to give you a WYSIWYG environment in which to tweak your control. Every property is available for modification through the menus, and there's even a Learn Mode that will record spreadsheet operations as you perform them and then generate VB code automatically. A 10-page quick reference guide makes the Interface Designer even easier to work with.

UNSURPASSED FORMATTING

The spreadsheet control provides unsurpassed cell-by-cell formatting. You can set foreground and background colors,

font name, size, and style, and even set any of the four edges of the cell to one of six line styles. Twelve cell types are available, including edit, check box, time, combo, button, and picture. Spread/VBX supports drag and drop much as Microsoft Excel does, allowing you to drag cells or ranges to a different location by grabbing the edges of the selection. You can assign formulas to cells, and with `SpreadAddCustomFunction` and `CustomFunction`, you can use any standard VB functions or your own code within a formula.

PRINTING FLEXIBILITY

The Action property gives you tremendous power in a single line of code. Any one of 32 actions can be performed on the spreadsheet by simply setting this property to the correct value. Using the action codes, you can cut, copy, and paste selections, print the spreadsheet, insert and delete rows and columns, recalculate the spreadsheet, and more. There are also over 30 functions provided to inspect and modify aspects of the spreadsheet.

A particularly outstanding feature of the Spread/VBX spreadsheet control is its printing flexibility. You can assign header and footer text, job names to display in the print manager, margins, and the pages to be printed. And if you print the spreadsheet by setting the Action property to a "smartprint" constant, the control will attempt to fit the spreadsheet on a single page by setting the orientation properly and even shrinking the size. The other standout feature is Spread/VBX's ability to load and save the contents of the spreadsheet to a spreadsheet or tab-delimited file.

Poor documentation is the one disappointment here. Although it details every property, event, and function, and provides a how-to chapter, there is no comprehensive discussion of this very detailed product. FarPoint also sells Grid/VBX (\$99), a scaled down, upwardly compatible version of Spread/VBX with about 100 properties.

► **Spread/VBX, Version 2.1.** FarPoint Technologies Inc., 569 Southlake Blvd., Richmond, VA 23236; 800-645-5913, 804-378-0432; fax, 804-378-1015.

Circle 489 on reader service card

Apex Software Corp.

• TrueGrid Pro

BY STEPHEN W. PLAIN

Apex Software Corp.'s TrueGrid Pro, Version 2.1, is an enhanced version of the grid control bundled with Crystal Reports Pro. This \$245 package offers some fine features, but it places a high emphasis on runtime customization of properties via code and offers limited cell control.

A TrueGrid Pro grid can be bound to the standard VB data control and access all of the databases available to it. TrueGrid Pro also lets you bind a grid to a data control on a separate form by setting the `DataSourceHwnd` property of the grid to the handle of the other form. You can customize the formatting of each cell, but while you can set the font color and style for each cell at runtime, you must use the same font and point size for the entire grid. This means your grids are limited to a homogeneous look that will probably suffice for database browsing, but will prove a drawback when it comes to truly customized applications.

Two other odd limitations hinder your use of the control. At runtime, you can only select rows—not columns or

ranges—and you cannot change the height of any row.

TrueGrid Pro is enhanced by the inclusion of some controls from other vendors. A slightly modified version of the CRYSTAL.VBX control included with Microsoft Visual Basic, Professional Edition, is included that lets you bind a Crystal report to the contents of the TrueGrid control. Three other controls, `CSCCombo`, `CSVlist`, and `CSOptionList`, are borrowed from Crescent Software's QuickPak Professional for Windows. These can be used to place combo boxes, list boxes, and radio buttons within a column. They are not available for use outside the grid, however. A Layout Editor is available at design time to set the properties of each column and establish the value lists to be used with these controls. The Layout Editor is helpful, but not nearly as full-featured as the one in Spread/VBX.

TrueGrid Pro does support user-controlled splits, drag and drop, and pictures in cells. However, its limitations may disappoint many developers.

► **TrueGrid Pro, Version 2.1.** Apex Software Corp., 4516 Henry St., Pittsburgh, PA 15213; 800-858-2739, 412-681-4343; fax, 412-681-4384.

Circle 490 on reader service card



Utilities & Widgets

Crescent Software Inc.

• QuickPak Professional for Windows

BY RICHARD V. DRAGAN

Crescent Software's QuickPak Professional for Windows, Version 3.2, packs a lot into its \$199 bundle. In addition to improved versions of the most common Windows controls, this general add-on gives programmers new controls that make designing user interfaces easier. QuickPak Pro also provides a code library with a comprehensive set of routines written in assembly language, giving programmers low-level access to the DOS file and other system functions. Crescent

has even thrown in Apex Software's TrueGrid, Standard Edition, a capable data-aware grid control.

The core library of consistent, 3-D controls in QuickPak Pro extends the abilities of its counterparts in default VB, fixing deficiencies or just making life easier when you're building user-interface forms. The Command Button controls, for instance, support bitmaps and a variety of shading options, while the Masked Edit controls can accept a range of values for long integers, double values, date and time values, currency, as well as general text input. List-box performance gets a boost with an enhanced control that supports multiple selections in both single and multiple

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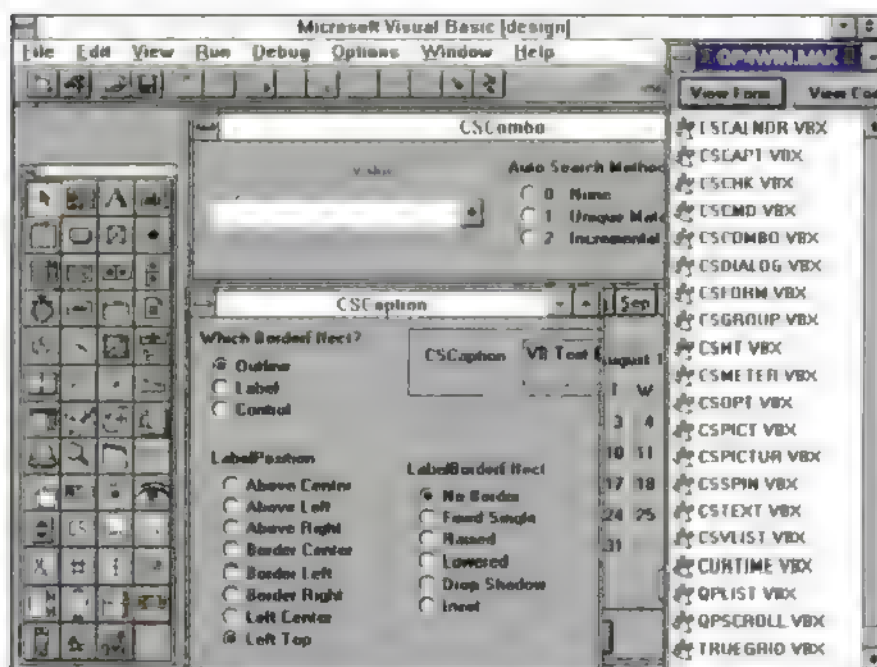


caere

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For Your Information.

CIRCLE 097 ON READER SERVICE CARD



QuickPak Professional for Windows not only goes standard interface objects one better, it provides controls that have no direct VB counterpart.

columns.

Beyond taking standard user interface objects one step farther, QuickPak Pro offers new user-interface widgets that make new form designs possible. The package delivers the long-absent spin buttons to VB, and a Calendar control lets programmers manipulate time present and time past. Another notable addition is the Hypertext control, which mimics the behavior of Help files with highlighted text hotspots that jump between topics. There are also new events available—AppActivate, AppDeactivate, Move, and MenuBrowse—that allow you to add useful behaviors to existing forms and controls.

HALF THE STORY

The second half of the power of QuickPak Pro comes from its dynamic link library, which contains optimized code for a wide variety of low-level routines. (Crescent provides full assembly language source code so you can examine how it's done.) QuickPak Pro includes optimized routines that build, sort, and delete entries in numeric and string arrays. Many of the code-library routines give you direct access to DOS or Windows calls, letting you poll system drives and directories, copy and rename DOS files and retrieve directory information stored by Windows, among many others operations. Other routines retrieve the state of the special control keys and provide enhanced mathematical functionality, including statistical and financial calculations.

QuickPak Pro's extremely useful Summary utility provides on-line help and a screen-capture option that facilitates grabbing graphics information for Picture controls and even for developing documentation for your end users. There is one Summary file for the entire Windows API set, a smaller Summary file for Windows constants only, and a third Summary file for the QuickPak Pro control properties and code library functions themselves. All are searchable and offer cut-and-paste, so you can add what you need to your program

effortlessly. If you like your help the old-fashioned way, the hefty two-volume printed documentation is thorough and clearly written.

Overall, this package is convincingly powerful and easy to use. QuickPak Pro is a good choice for anyone starting a VB tools pegboard.

► **QuickPak Professional for Windows, Version 3.2.** Crescent Software Inc., 11 Bailey Ave., Ridgefield, CT 06877; 800-352-2742, 203-438-5300; fax, 203-431-4626.

Circle 491 on reader service card

Desaware

• SpyWorks-VB

BY RICHARD V. DRAGAN

It's long been difficult, if not downright impossible, to make certain low-level Windows API calls from within Microsoft Visual Basic. Desaware's SpyWorks-VB, Version 2.0 (\$129), lets you evade those limits, giving you the power and performance of the full Windows API.

SpyWorks-VB employs a strategy called *Windows subclassing*, something akin to placing a wiretap on a VB control to listen in before it receives a message and fires off an event. The Generic Subclass Control in SpyWorks-VB uses subclassing to listen for and intercept any desired Windows message and then do customized processing, like painting a customized control. A simpler control, the Easy Subclass Control, handles the most common message types, including mouse and menu-browsing messages.

With this control, you can draw a customized window caption or add status-bar help to your application.

SpyWorks-VB also provides Windows hooks, another powerful tool formerly off-limits to VB programmers. The Keyboard Hook Control lets your control intercept keystrokes before they are read by other programs, a perfect method of installing hotkeys systemwide. A General Hook Control offers even more drastic leverage for Windows espionage. You can install a hook systemwide and intercept every system message and examine it. An additional control provides access to call-back functions, API functions previously unavailable from VB.

SpyWorks-VB also provides a set of standalone utility programs that resemble the "spy" utilities shipped with many Windows C/C++ compilers. SpyMsg shows the stream of messages delivered to controls and corresponding VB events. SpyWin lets you browse through the hierarchy of windows on a form. SpyVBX reveals internal data associated with every VB control.

SpyWorks-VB may be just the answer to performance needs for those programmers who feel a little put-upon by the traditional limits of Microsoft Visual Basic.

► **SpyWorks-VB, Version 2.0.** Desaware, 5 Town & Country Village, #790, San Jose, CA 95128; 408-377-4770; fax, 408-371-3530.

Circle 492 on reader service card

Sheridan Software Systems Inc.

• VBAssist

BY RICHARD V. DRAGAN

Once you've tried Sheridan Software's VBAssist, Version 3.0, you probably won't want to go back to Microsoft Visual Basic programming without it. The \$179 toolkit integrates seamlessly with the VB environment to provide quicker access to VB functions and easier tracking of control properties.

VBAssist adds a double row of toolbar buttons to the VB interface, letting you bypass the VB menu structure. Simply clicking on a button lets you access functions, such as adding and deleting files to a project, displaying the Toolbox and Project windows, or creat-

ing an .EXE file. The buttons for common functions like search and replace are also simple but powerful enhancements.

VBAssist also offers new functions that make designing your application's controls easier. Click the right mouse button and you gain access to the Property Assistant, which manages properties by category. You get quick access to the property category you

HIGH-LEVEL ASSISTANTS

Beyond those simple niceties, VBAssist offers an additional trio of more powerful tools. The Code Assistant lets you edit source code snippets (up to 55K) from any VB file, and its multiple document interface lets you manage more than one source file. With the Code Assistant, you can paste code from older projects to a new project, without having to add the old file to the new project's .MAK file.

VBAssist's Code Librarian lets you store commonly used procedures so you can collate and reuse code more efficiently. The Data and DB Assistants in VBAssist allow you to browse your databases conveniently (including Microsoft Access, Xbase, and any ODBC-supported SQL database), create new tables, and build indexes. You can edit live data from your tables in a grid, as well as create default browse screens for any given table with VBAssist's Form Wizard.

What is the price for all this added functionality? Just under 3MB of hard disk space and the addition of a DLL to your project at design time. The DLL is automatically added by the environment itself and steps aside when you create an .EXE file from your source code. The best thing about VBAssist is that its power works seamlessly with the existing VB environment, while improving your productivity with its advanced and quite impressive toolset.

► **VBAssist, Version 3.0.** Sheridan Software Systems Inc., 35 Pinelawn Rd., #206-E, Melville, NY 11747; 516-753-0985; fax, 516-753-3661.

Circle 488 on reader service card

AJS Publishing Inc.

• VB/Magic Controls

BY DAN SMITH

VB/Magic Controls, Version 1.54, from AJS Publishing, is a powerful graphical toolbox that lets you create customized Microsoft Visual Basic controls without having to use the Visual Basic Control Development Kit (CDK) or the Micro-

soft Windows SDK. With VB/Magic, you can create many advanced control types not directly supported by VB, and you can customize their appearance in almost any way you please.

The core of the package is Magic ControlEditor, a standalone Windows program that lets you create controls in four broad categories: command buttons, slider controls, toolbars, and tool palettes. The visual design tools are intuitive, and pop-up help is always available. The ControlEditor gives you the option to add text and bitmapped images to your controls and use shading effects to give your application a slick, three-dimensional look. If you go beyond the supplied bitmapped images, though, you'll need to use Windows Paintbrush or a third-party bitmap editor.

REUSABLE RESOURCE FILES

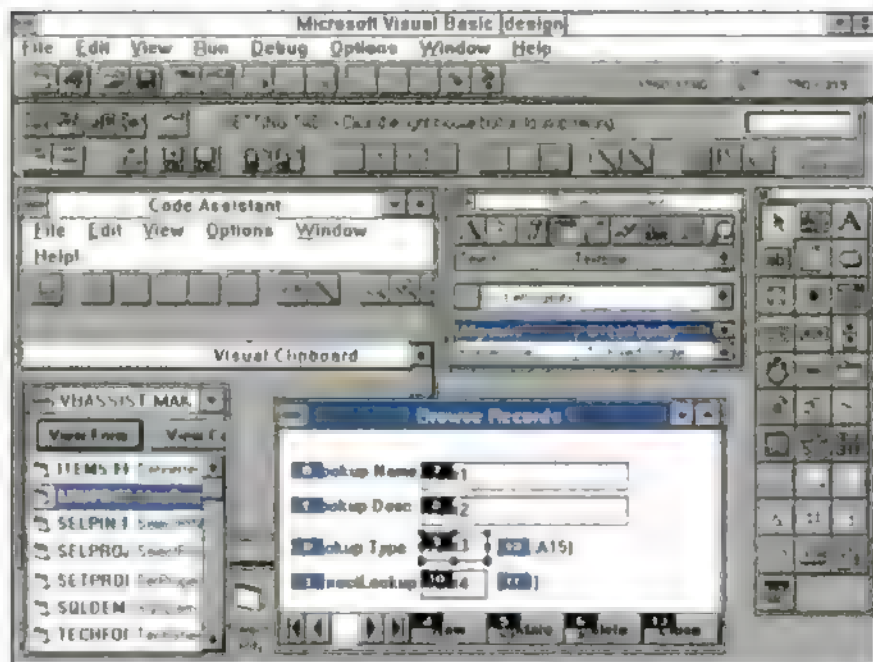
Once your control is complete, the ControlEditor saves your work as a Windows resource file, an editable format containing the information VB needs to incorporate your control. You can also load resource files into many popular C compilers. Controls are placed in your application using VB's picture box control, and they can be called with a single function.

Controls that were created with VB/Magic have all the basic properties of standard VB controls and support appropriate events like Click, DblClick, and GotFocus. VB/Magic does not produce bound controls, however. If you want to emulate a data-aware control, you'll need to code it yourself. VB/Magic also has options for creating dialog boxes, pop-up menus, and menu groups. You can also add bitmapped icons to your menus.

VB/Magic Controls, which sells for \$149, includes 44 examples to demonstrate the package's powerful capabilities. The clear documentation includes the ControlEditor manual, a function reference, and a good overview of Common User Access (CUA) objects you may add to your applications.

► **VB/Magic Controls, Version 1.54.** AJS Publishing Inc., P.O. Box 83220, Los Angeles, CA 90083; 800-992-3383, 310-215-9145.

Circle 494 on reader service card



VBAssist's Tab Order tool lets you quickly edit the tab order of all controls on a form. The TabIndex property of every selected control is updated for you automatically.

need, without navigating through the entire property list of a control. With VBAssist's Templates tools, you can define and then reuse combinations of properties as templates to ensure a consistent look and feel throughout an application—a real time-saver, especially for more complicated effects like three-dimensional controls. VBAssist also provides handy Alignment and Tab Order tools to make forms creation in VB easier.

Another winning feature in VBAssist is the Picture Management window, which allows you to create and manage bitmapped images—including icons—for use as Image or PictureBox controls, bitmapped push buttons, and any other graphical control properties. This window lets you grab images from the screen and immediately save them to a file, the clipboard, or your control. More conventionally, you can use an existing file or the clipboard to get a bitmapped image. Although you still may need an icon editor, you can now rely on images displayed on the screen and incorporate them within your controls.

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Graphics & Multimedia

ImageFX

• FXTools/VB, Standard Edition

BY SHERYL CANTER

FXTools/VB, Standard Edition, Version 1.4, from ImageFX lets you display text, shapes, and bitmapped images with striking style. Successive images can be displayed with fades, wipes, multipass dissolves, and dozens of other special effects. The results are dramatic and impressive.

The package provides four custom controls. The Image, Label, and Shape controls emulate their standard Microsoft Visual Basic counterparts while offering many additional properties. The Rotating Text control lets you rotate TrueType fonts at any angle.

The special effects provided by FXTools include 50 Main Effects such as wipes, diagonals, pushes, pulls, splits, blinds, and crushes; 42 Dissolve Effects, each of which can be displayed in one, two, or three passes; and colored 3-D bevels and borders. All of these are set through the Property sheet.

In addition to the Main and Dissolve effects, the controls offer additional features such as Multitasking, which lets you perform background tasks like playing sound at the same time as special effects are being displayed, and Transparency. The Label and Rotating Text controls offer six 3-D font styles.

You can combine special effects in innumerable ways. Display speed is controlled through two Properties: Grain and Delay. The Grain is the size of the smallest unit used to display an effect. For example, in displaying an image, the Grain is the number of pixels in a block. Small Grains produce a smoother, but slower, effect. The Delay is the time between the display of each Grain.

FXTools comes with a well-written manual and a sophisticated demonstration program, which shows off the product's features to excellent advantage, and also serves as a terrific teaching tool.

Technical support is free for registered users.

This summer ImageFX was readying two new versions of the product: an upgrade to the Standard Edition (\$169) and a new Professional Edition (\$299) that will add even more advanced functionality.

► **FXTools/VB, Standard Edition, Version 1.4.** ImageFX, 3021 Brighton-Henrietta Town Line Rd., Rochester, NY 14623-2749; 800-229-8030, 716-272-8030; fax, 716-272-1873.

Circle 495 on reader service card

Pinnacle Publishing Inc.

• Graphic Server SDK

BY SHERYL CANTER

Graphic Server SDK, Version 2.5, from Pinnacle Publishing, provides a sophisticated and full-featured API for scientific and business graphing. It can be accessed through DDE, or function calls to a DLL (dynamic link library). Bundled with the \$299 package is ChartBuilder, a VB custom control that relies on Graphic Server for its capabilities and provides visual access to Graphic Server's many features.

ChartBuilder is also sold separately for \$199. The only difference between the two packages is Graphic Server's inclusion of the Graphic Server manual, which documents the API. Since ChartBuilder relies upon Graphic Server, the server software is included in both packages. The earlier 2.0 release of Graphic Server and ChartBuilder ship with Microsoft Visual Basic 3.0, Professional Edition.

GRAPH CONTROL

The ChartBuilder graph control lets you build a rich variety of scientific and business graphs. By simply setting a property in the graph control, you can create area graphs, bar graphs, bubble charts, Gantt

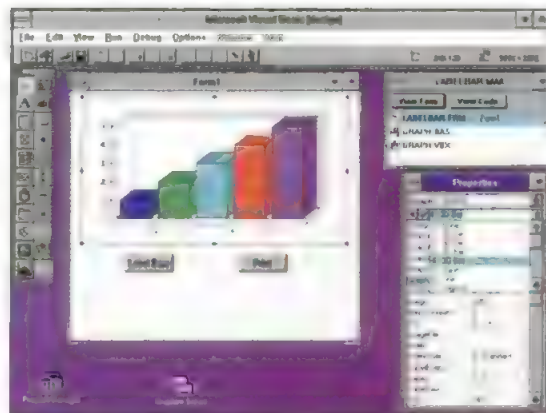
charts, high-low-close graphs, line and log/lin graphs, pie charts, polar graphs, scatter graphs, and tape graphs.

ChartBuilder 2.5 provides a number of features that aren't in the older version. One of the most powerful is the Hot-Graph system, which makes graphs and charts interactive. With HotGraphs, your graphs respond to mouse clicks by reporting the data set and data point represented by the graphical object that was clicked. With this feature, end users can click on a bar, pie slice, or point and see detailed information about the data represented by that graphical element.

Printing capabilities have also been enhanced. You can include more than one graph on a printed page, and you can incorporate text and graphics on the same page. Another addition is the ability to set minimum and maximum values for x-axes as well as y-axes. Version 2.5 also gives you the ability to drop points of a line graph without causing the line to fall to zero; you can have the line stop and then start again somewhere else.

The ChartBuilder graph control calls Graphic Server API functions to perform its tasks and provides a subset of the Graphic Server capabilities. With the Graphic Server SDK, you have access to the full feature set of the library from languages other than VB.

Applications can communicate with



Graphic Server SDK is a full-featured scientific and business charting library. You can visually access its features through the bundled ChartBuilder custom control.

Graphic Server through calls to DLL functions, or via DDE. The DLL interface is simpler, but DDE support is provided so this SDK can be used with 4GL development tools that don't support DLL calls.

Graphic Server also can be used with 3GLs such as C, C++, and Pascal. And, of course, you can also call Graphic Server functions directly from Visual Basic.

When Graphic Server is active, it appears as an icon at the bottom of your screen. It is called a *server* because you need only load it into memory once to provide graphics services to many apps simultaneously. Also, a single client application can use Graphic Server to open many graph windows simultaneously.

Graphic Server SDK provides a powerful and full-featured graphing and charting system that can be accessed visually from the ChartBuilder graph control, or through direct calls to the Graphic Server API. Runtime files may be distributed without royalties. The package is well documented, powerful, and easy to use—an excellent buy.

► **Graphic Server SDK, Version 2.5.** Pinnacle Publishing Inc., P.O. Box 888, Kent, WA 98032; 800-231-1293, 206-251-1900.

Circle 496 on reader service card

Media Architects Inc.

● ImageKnife/VBX, Professional Pack

BY SHERYL CANTER

ImageKnife/VBX, Version 1.3, provides all the features of the Visual Basic Picture Box—plus many more. The \$299 Professional Pack significantly extends the number of graphics formats you can work with and provides a rich set of image-manipulation and color-processing features. Images are manipulated in memory for fast performance, and all calculations except non-90-degree rotation are done using speedy integer arithmetic. This means that ImageKnife does not require a math coprocessor for acceptable performance. The package comes with a 90-day return policy, and there are no runtime royalties.

*One use of ImageKnife
is to create file-format
conversion applications,
but the product
supplies far more than
simple filtering.*

MANY FORMATS

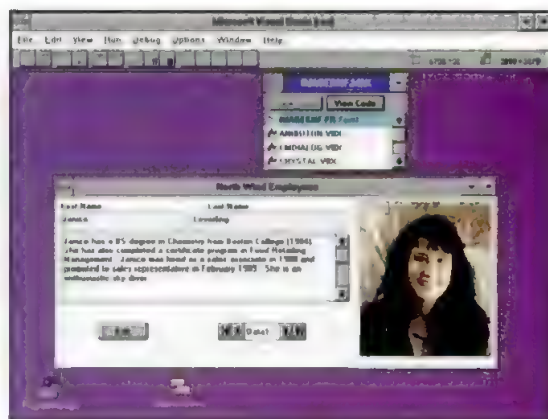
The ImageKnife custom control, PicBuf, can handle 24-bit (true color), 8-bit, 4-bit, and monochrome images. It also provides full printer support, allowing you to print images on any Windows device, including color Postscript printers. ImageKnife can read most popular bitmap formats: .BMP, .DIB, .GIF, .JPG, .PCX, .TIF, and .TGA. Its support for the OLE Paintbrush Object format used in Microsoft Access 1.x is unique. In addition, you can write images to disk in any of these formats, so ImageKnife can be used to write conversion utilities.

You can also acquire images by scanning them in, taking advantage of ImageKnife's Twain Scanner Interface support. Twain is a device-independent API that gives access to scanners though manufacturer-provided drivers. ImageKnife's Twain support is especially complete, and includes access to the Twain negotiation capability. This lets developers write their own interfaces for scanners that support this feature.

POWERFUL IMAGE PROCESSING

One obvious use of ImageKnife is in creating file-format conversion applications, but it provides far more than simple filtering. After images are loaded into memory they can be rotated, smoothed, sharpened, resized, cropped, or combined with other images. You can create mirror images, and perform gamma adjustments.

ImageKnife also offers extensive color-processing tools. You can force a palette by dithering, convert to gray scale, reduce colors, increase color depth (number of bits per color), create negative images, optimize the palette (find the palette that is the "best fit" among multiple images), and edit or remap the palette. Images also can be accessed via .DIB handles and



ImageKnife/VBX's support for the Microsoft Access bitmap format from within VB is unique—but it's only a small facet of this powerful graphics product.

processed with scan-line get/put functions.

Many of the ImageKnife features are available through the PicBuf control by simply setting its properties. An API is also included for programming advanced graphics capabilities. PicBuf is data aware, and can be used as a bound control for databases managed by the Access engine included with VB 3.0.

The ImageKnife documentation is well-written and thorough. You can obtain free technical support by fax, CompuServe mail, Internet mail, or by posting questions on the Media Architects BBS. Telephone support is free for 90 days from your first call, but after that each phone call costs \$20.

There are packages that support more formats or offer more image processing functions, but ImageKnife provides a good balance between the two feature sets and at a reasonable price. A Standard Edition (\$199) is available without Twain Scanner and JPEG support.

► **ImageKnife/VBX, Version 1.3, Professional Pack.** Media Architects Inc., 1075 NW Murray Rd., #230, Portland, OR 97229-5501; 503-297-5010; fax, 503-297-6744.

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VisualTools Inc.

● ImageStream/VBX

BY SHERYL CANTER

If you need to read images in virtually any file format, consider ImageStream/VBX, Version 1.01, from VisualTools (\$295). The ImageStream custom control works

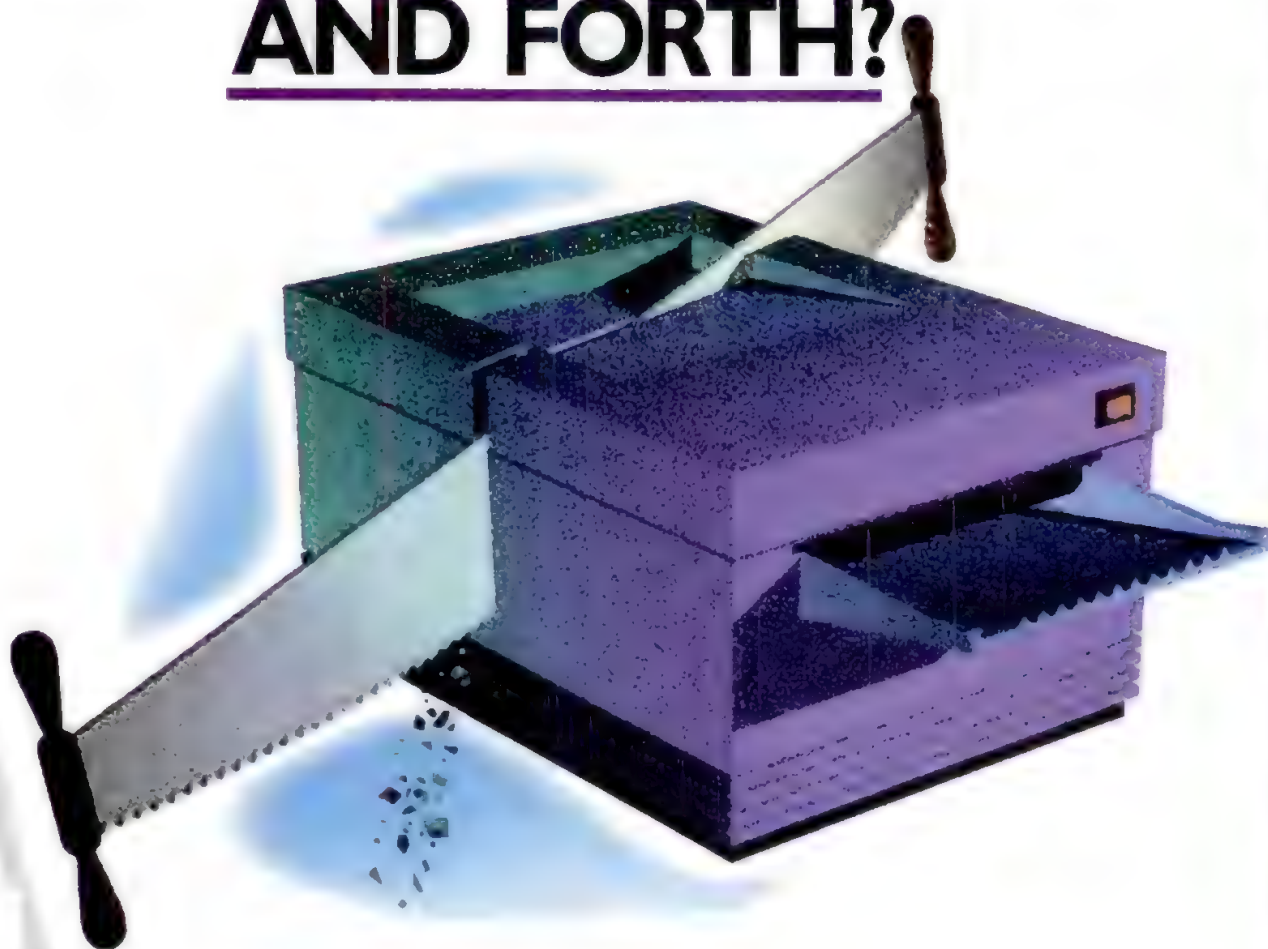
VBXs: The Short List

Listed below are the third-party custom controls that we loaded up and examined in preparation for this story but did not include in the capsule reviews. Many of the tools provide strong solutions to complex problems. If you need specialized capabilities for a project but can't spend a lifetime writing all the code yourself, check out what's

already out there. A comprehensive catalog of available tools, *Component Objects and Companion Products*, is bundled with each copy of VB and is available directly from the publisher at \$7 per copy. Contact Fawcette Technical Publications, 280 Second St., #200, Los Altos, CA 94022-3603; 415-917-7850.

Product	Company	List price	In short
AccuSoft Image Format Library	AccuSoft Corp., 112 Tumpike Rd., #109, Westboro, MA 01581; 800-525-3577, 508-898-2770; fax, 508-898-5062	\$495.00	AccuSoft Image Format Library is more expensive than its competitors, but it offers unusually broad image-format support and a sophisticated set of image-control functions.
CCF-Cursors	Desaware, 5 Town & Country Village, #790, San Jose, CA 95128; 408-377-4770; fax, 408-371-3530	\$35.00	CCF-Cursors lets you create custom cursors, including animated cursors, choosing from over 50 sample cursor images. The package extends the control of mouse events within VB, including support for creating status lines.
CodeBasic	Sequiter Software Inc., P.O. Box 575, Newmarket, NH 03857; 403-437-2410; fax, 403-436-2999	\$245.00	This package includes the CodeBasic Xbase engine DLL, CodeReporter Xbase report writer, and CodeControls, a set of four data-bound controls. CodeReporter is also available separately for \$195.
CodePrint Pro for Visual Basic	Pinnacle Publishing Inc., P.O. Box 888, Kent, WA 98035-0888; 800-231-1293; fax, 206-251-5057	\$99.00	This add-on allows you to print all your VB code with flexibility and control. It supports a variety of formatting options and lets you create indexes to your VB modules and sets of files and procedures that can be saved and recalled later during a project.
Custom Control Factory	Desaware, 5 Town & Country Village, #790, San Jose, CA 95128; 408-377-4770; fax, 408-371-3530	\$48.00	Custom Control Factory lets you create custom buttons, with support for animated buttons, multistate buttons, enhanced buttons, check boxes, and option controls. This low-cost package makes designing intuitive interface objects easy.
DataTable VBX Spreadsheet Control	ProtoView Development Corp., 353 Georges Rd., Dayton, NJ 08810; 800-231-8588, 908-329-8588; fax, 908-329-8624	\$249.00	DataTable is both a class library for Microsoft Visual C++ and a custom control for VB that provides spreadsheet functionality. It features 22 predefined data types, including all standard SQL types.
Designer Widgets	Sheridan Software Systems Inc., 35 Pinelawn Rd., #206E, Melville, NY 11747; 516-753-0985; fax, 516-753-3661	\$129.00	Designer Widgets lets you add the latest interface gadgets to your apps. With the Dockable Toolbar control you can build movable, customizable toolbars. The Index Tab control lets you build forms that employ a tabbed-notebook metaphor, while the Form FX control lets you customize the caption area of an application form.
Formula One	Visual Tools Inc., 15721 College Blvd., Lenexa, KS 66219; 800-884-8665, 913-599-6500; fax, 913-599-6597	\$295.00	More than a simple grid control, Formula One is a fully functional, Microsoft Excel-compatible spreadsheet module. Its ability to read and write Excel files, excellent report-writing capabilities, and 126 built-in functions make this the most powerful tool in its class.
HighEdit Pro	MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066-1135; 800-922-3383, 404-516-0899; fax, 404-516-1099	\$495.00	HighEdit Pro adds a robust, text-based WYSIWYG editor to your VB programs, including mail-merge functions and print capabilities. It provides source code for Pascal and C.
ImageBasic	Diamond Head Software Inc., Ocean View Center, #630, 707 Richards St., Honolulu, HI 96813; 808-545-2377; fax, 808-545-7042	\$1,395.00	With ImageBasic you can build custom document-imaging apps utilizing scanning, OCR, hand-print recognition, and bar-code reading capabilities. It supports OCR engines from Calera, Nestor, Ocron, and Xerox. The Scanning Control supports over 100 desktop scanners. It's not cheap, but ImageBasic is well suited for high-end imaging apps.
Muscle	MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066-1135; 800-922-3383, 404-516-0899; fax, 404-516-1099	\$129.00	Muscle gives VB programmers speedy access to DOS file-system (including file-compression), keyboard, and time functions, as well as routines for string handling, data validation, and enhanced floating-point functions.
Network Library	MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066-1135; 800-922-3383, 404-516-0899, fax, 404-516-1099	\$99.00	Network Library brings NetBIOS and NetWare API functionality to VB, so you can deliver network-aware applications for NetWare, NetBIOS, and LANtastic LANs.
PDQ Comm for Windows	Crescent Software Inc., 11 Bailey Ave., Ridgefield, CT 06877; 800-352-2742, 203-438-5300; fax, 203-431-4626	\$149.00	PDQ Comm takes over the chore of serial communications with an enhanced version of the MSComm control, and it gives your VB programs the ability to transfer files using a variety of popular protocols. It also provides a host of terminal-emulation options.
VBTools	MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066-1135; 800-922-3383, 404-516-0899; fax, 404-516-1099	\$129.00	VBTools is a powerful library of user interface controls that offer a consistent 3-D look and feel. It provides controls that encapsulate and enhance existing VB objects, as well as new types of objects such as sliders and charts.
VBtrv for Windows	Classic Software Inc., 3542 Pheasant Run Circle, #B, Ann Arbor, MI 48108; 313-677-0732; fax, 313-971-3287	\$249.00	VBtrv for Windows has custom controls for accessing NetWare's Btrieve. It also includes a Windows-based data-dictionary editor for Btrieve and a 346-page Btrieve manual.
VBViewer	MicroHelp Inc., 4359 Shallowford Industrial Pkwy., Marietta, GA 30066-1135; 800-922-3383, 404-516-0899; fax, 404-516-1099	\$99.00	VBViewer allows the user to view contents of over 20 types of data file formats, including those for popular word processor, database, spreadsheet, and graphics apps. It also supports a drag-and-drop Windows interface.
VSVBX: VideoSoft Custom Control Library	VideoSoft, 2625 Alcatraz Ave., #271, Berkeley, CA 94705; 510-547-7295	\$45.00	VSVBX offers an Elastic control for resizing child windows and a TabIndex control, which provides a notebooklike user interface object. You also get the functionality of a Unix AWK text parser within VB.
Windows Help Magician	Software Interphase Inc., 82 Cucumber Hill Rd., Foster, RI 02825; 800-542-2742; fax, 401-397-6814	\$199.00	Windows Help Magician creates hypertext Help files for your VB (or C/C++) programs, including support for managing multimedia sound, video, and bitmapped files. This is a handy utility, but you'll still need a good grasp of the nuts and bolts of the Windows Help system.
XRef for Visual Basic	Crescent Software Inc., 11 Bailey Ave., Ridgefield, CT 06877; 800-352-2742, 203-438-5300; fax, 203-431-4626	\$99.00	XRef is a documentation and reporting tool that lets programmers create listings of all symbols used within a VB project. It can generate a list of all symbols, find duplicate symbols, and create procedure trees. The package is especially useful for maintaining large VB projects.

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much like VB's Picture Box, but offers greatly enhanced format support along with some image-processing capabilities not available natively in VB. VisualTools licenses graphics filters directly from ImageMark, the company that supplies filters to major publishers such as Adobe, Microsoft, and Lotus, so ImageStream's format support is exceptionally complete and up-to-date.

The product provides 23 import formats and 17 export formats, including vector images, bitmapped images, and hybrid formats with both vector and bitmapped components. Some of these, such as Kodak Photo CD support, are unpublished formats for which no other tool vendor provides filters. The downside is that you must pay royalties to VisualTools if you sell more than 100

copies of an application that uses ImageStream. VisualTools pays to license these filters, and the cost is passed along to you, the developer.

IMAGE MANIPULATION

In addition to its extensive format support and conversion capabilities, ImageStream provides some image-management features. You can manipulate an image's size, color, brightness, contrast, and gamma setting. The product provides support for palette manipulation, though the options are not extensive. Image-manipulation instructions are stored in preference files with an .INI extension.

The ImageStream/VBX

custom control even

supports some

unpublished image for-

ats, such as the Kodak

Photo CD format.

The .INI settings can be changed through prewritten dialog boxes that you activate via control Properties. Image manipulation tends to be slow because of ImageStream's support for both raster and vector formats.

The ImageStream custom control is data aware, and can be bound to a VB data control, which provides a connection to the Microsoft Access engine. Since the native Access image format is not supported, images are stored in Windows Metafile format, or as references to image files that are displayed when called.

ImageStream provides only basic image-manipulation features and has no Twain support, so for these applications, you may want to look elsewhere. But you won't find a package with more comprehensive image-format support. □

► **ImageStream/VBX, Version 1.01.** VisualTools Inc., 15721 College Blvd., Lenexa, KS 66219; 800-884-8665, 913-599-6500; fax, 913-599-6597.

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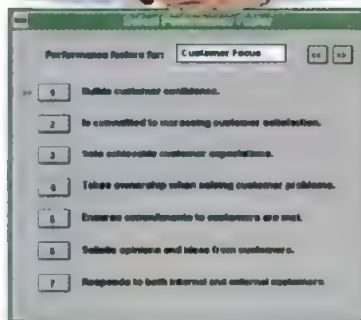
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First Looks

► COMMUNICATION SERVERS

Remote Access: It All Comes Down to Management

We test four communication servers
for remote *and* local users.

By O. Ryan Tabibian

While many remote-access servers let users dial into or out of a LAN, over the past six months four vendors released remote-access servers that offer both of these functions.

We tested these servers and found that they make remote access more reliable and more manageable than it's ever been.

The key to these four communication servers—Cubix Corp.'s ERS/FT, Evergreen Systems' CAPserver, J&L Information Systems' ChatOffice, and Multi-Tech Systems' Multi Com Tower—is the

integration of NetWare Connect, Novell's new remote-access communications package that offers both dial-in and dial-out capabilities. NetWare Connect lets you deploy two types of dial-in service: remote node and remote control. With remote node, a PC dialing into the LAN becomes a node on the network. With remote control, a user who is dialing into the LAN remotely can gain control of a specific machine. For a further explanation of NetWare Connect, please refer to the sidebar "NetWare Connect: How It Works."

Each server was configured for testing with four remote-control boards; an 8-port serial expansion card; NetWare,

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VLANs: Hero or headache?

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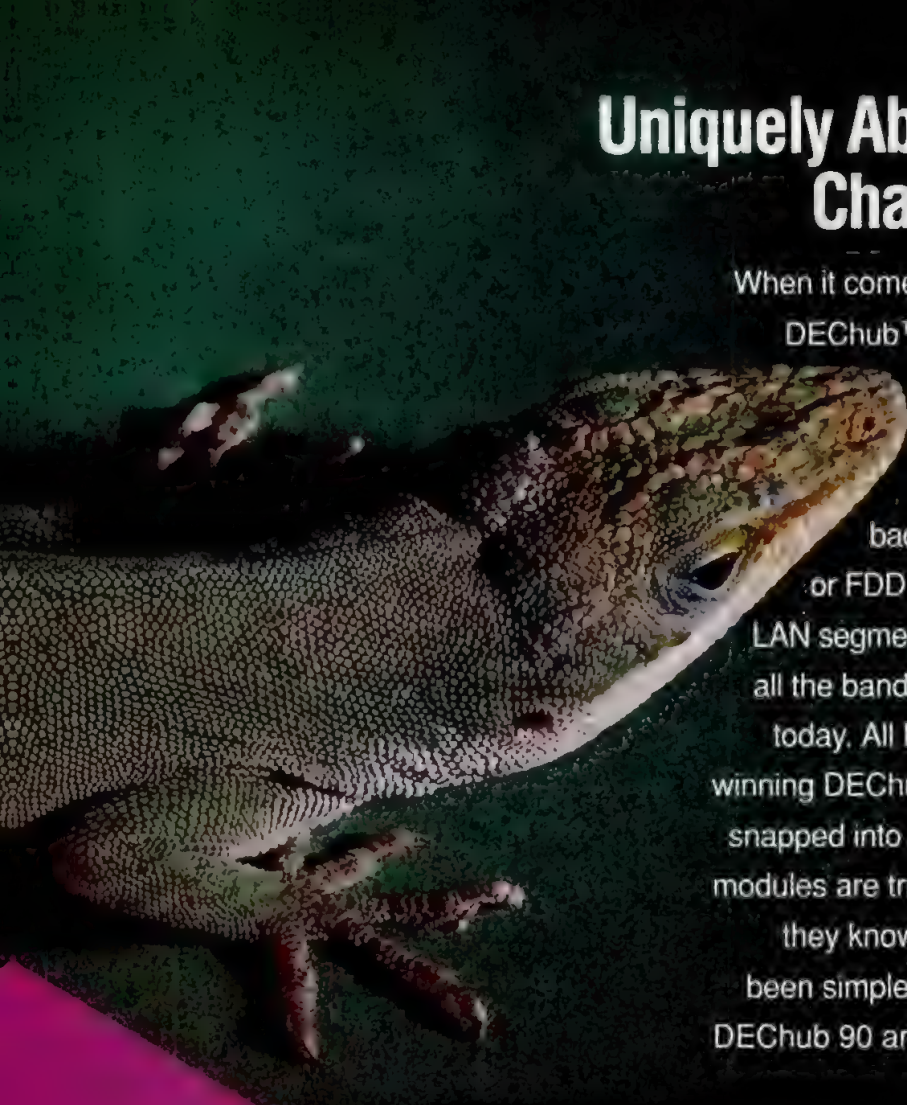
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Communication Servers

CONTINUED FROM NE1

Version 3.12; and NetWare Connect, Version 1.0.33.

Because they offer sophisticated hardware platforms, which can automatically reboot a processor, and they support dial-in and dial-out, these communication servers represent the high end of the remote-access market. These communication servers provide centralized, flexible, and user-friendly management functions. They are an ideal albeit expensive (the servers we tested ranged in price from \$18,000 to \$30,000 instead of roughly \$1,000 to \$5,000 for a remote-node server), choice for managing a large number of remote-control sessions (4 to 24) while offering the flexibility to run remote-node sessions with NetWare Connect.

Users who can't afford these prices should consider individual remote-node servers or remote-control software (see "Extend Your Reach" and "How to Be in Two Places at Once," August 1994). More specifically, while remote-node servers tend to offer limited expandability, these servers were far more complex.

Each server consists of a 19-inch chassis that holds multiple independent processor cards (PCs on a card) and standard multiport serial cards (such as a DigiBoard 8EM) to which you connect multiple modems. Each processor card comes with an integrated or separate network adapter. These processor cards use remote-access software such as Novell's NetWare Connect or DCA's RLN/2 for managing remote sessions. The servers also include remote-control software such as Ocean Isle's ReachOut Total Remote, Version 4.02.

Each vendor also provides its own flavor of management software. It's these two elements—manageability and hardware design (specifically, scalability, flexibility, and fault tolerance)—that we found form the key purchasing criteria for communication servers.

MANAGEMENT FIRST

Perhaps the most important factor to keep in mind when considering a communication server is reliability. And a com-



● Evergreen CAPserver

Management capability is what distinguished our Network Edition Editors' Choice. All of the communication servers offer comparable hardware, but the CAPserver features the most management abilities. The CAPserver is the only product

that integrates management software seamlessly with NetWare Connect and provides a full set of management features, such as comprehensive status information, on each processor board. The product also provides the ability to control each host board from within NetWare. These features are unsurpassed by any other product.

Its hardware design also gets strong marks, providing a large-capacity chassis with the ability to house 20 remote-control hosts. Only the Cubix, with its processor-doubling capability, can accommodate more.

Cubix was a close second with its ERS/FT. Cubix offers the best fault-tolerant hardware platform in our roundup, with dual power supplies and fans. In fact, the Cubix hardware is in some ways superior to the CAPserver's because of its 32-bit backplane (which can be beneficial when there are heavy I/O transfers) and its ability to house four more processors than the CAPserver (a total of 24). But it falls short in the most important of features—management. Its management features

include a power-loss warning and an out-of-band management system for resetting boards in case of a crash. Missing from the ERS/FT is detailed port status information, just one of the features provided by the CAPserver.

J&L's ChatOffice provides a good hardware feature set, complete with hot-swappable boards and a chassis-based design that provides flexibility and ease of installation. However, it also falls short on the management front. To its credit, the ChatOffice does offer an impressive feature: a plug-in module for Novell's NetWare Management System (NMS), Version 2.0, that lets users control the server. The server is lacking in port density, and it can only support seven remote-control boards.

Multi-Tech provides the most comprehensive product—a chassis design that incorporates a built-in UPS and modem rack. It also provides an excellent management software package, its own ME Host, to manage its modems, but it lacks any management for the remote-control boards. This is a major limitation of the Multi Com Tower.

munication server's reliability depends on the level of functionality within its management features. There are two types of management features that we looked for and tested: unattended and attended.

Unattended management is the automatic reboot of processor boards. When something goes wrong on one of the host processor boards, such as a software or hardware crash or the loss of a phone connection, the server will automatically reboot the processor board.

The servers offer different levels of this kind of functionality. Most remote-control software packages, including

those in this roundup, can reboot the processor when you lose the phone connection. All of the communication servers except the Multi-Tech Multi Com Tower offer management software that will reboot a processor card.

Unattended reboot is critical since communication servers will normally crash as a result of one of the following three reasons: a hung processor, a NetWare crash, and Windows errors. Being able to reboot in these three areas is crucial. We simulated a hung processor by running a small debug program that

Continues on page NE7

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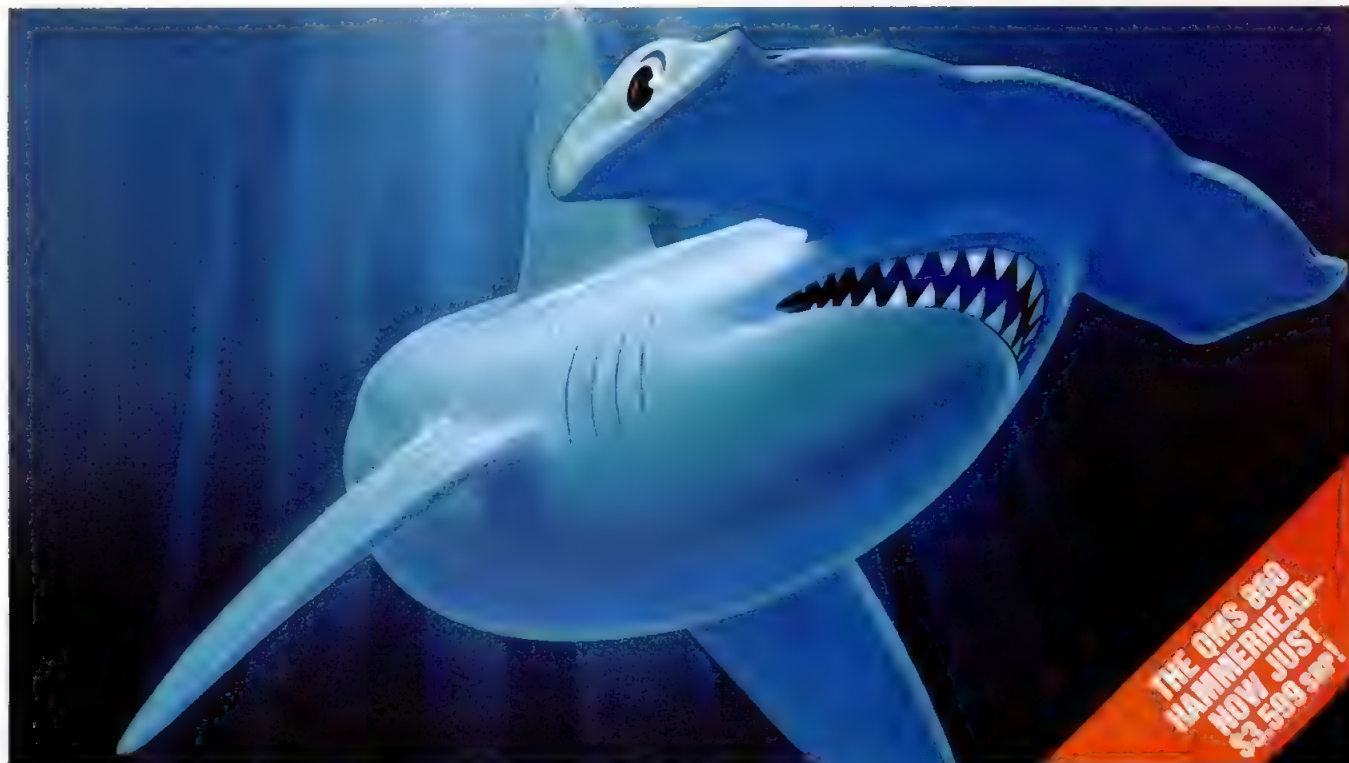
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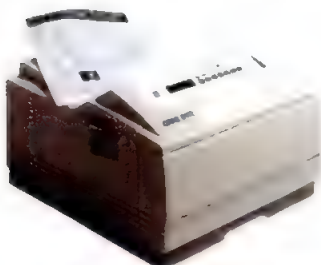
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November 23, 1993
QMS 860 Print System

Communication Servers

CONTINUED FROM NE4

causes a memory error. We created a Windows general protection fault (GPF) using a special diagnostic tool. And we crashed the NetWare server by using a NetWare Loadable Module (NLM) specifically designed for that task.

Unfortunately, not all problems can be automatically diagnosed and solved. Network managers need to be called for *gray-area crashes* such as a GPF in Windows. At times, we needed to reboot the processor boards manually in the event of a GPF. To fix these problems, they need attended management features such as manual reboots, access to detailed board information, and remote administration of each processor. Evergreen's CAPcon was the only management software to offer all of these features.

One caution: You don't want to reboot blindly every time a problem occurs. It's important to understand what's causing the problems. Each of the servers provided some view of its status. Detailed information of each host processor board, such as the applications loaded and user connections, help the network manager troubleshoot problems. The CAPserver provided the best status information with detailed, up-to-the-minute menus of processor and connection status. Both the ChatOffice and the ERS/FT offered less information, and while the Multi Com Tower offered no processor board information, it did provide a helpful diagnostic tool for the modem pool. Multi-Tech offers a separate product, ME Host, that provides processor information.

CAPserver also offers a very useful feature—a remote-attachment utility that lets the administrator control each board via NetWare, making configuration changes easy. The CAPserver redirects screen and keyboard information and provides control of each board via the NetWare console using the server's keyboard and monitor. All of the other products, except ChatOffice, require you to make changes at the management console.

And when the network crashes, it's helpful to be able to reset the system through another link. All the vendors except Multi-Tech offered such an out-of-

band management system.

Another attended management feature that we gave a nod to was the inclusion of SNMP support. Only two of the vendors provided this type of support—Cubix Corp. and J&L. The level of support ranged from SNMP alarms to the network manager's enterprise SNMP

*When the network
crashes, it is helpful to be
able to reset
the system through
another link.*

management platform to integration with Novell's NetWare Management System (NMS), Version 1.0.

INSIDES AND OUTSIDES

Management aside, you must consider the communications server's hardware design. This includes the I/O bus design, which comes in two flavors: 16-bit or 32-

Suitability to Task: Communication Servers

With management capabilities, you can transform a bunch of independent processor boards into a robust and reliable communications platform. But a communication server cannot be judged on management abilities alone. We assessed each of these products in four critical areas:

Management We looked at two aspects of management. First, we evaluated how each communication server recovers from hardware and software faults such as Windows general protection faults, processor hangs, and pulled cables. Second, we evaluated the effectiveness and ease of use of the management software and the extent to which it allows the network manager to monitor, configure, and troubleshoot.

Hardware design We evaluated the design based on how well the hardware fit together. We looked at

bit. Scalability, flexibility, and fault tolerance are also key. To evaluate scalability, we noted how many processor slots the products offered. When users begin to clamor for more connections, only a minor upgrade should be required. Of the servers reviewed, the Cubix ERS/FT and the Evergreen CAPserver featured a 24- and 20-processor capacity, respectively. The Cubix traditionally offers a maximum of 12 processors per server, but you can boost that number to 24 because the Cubix also allows you to configure each board with two processors. Users might experience a performance degradation with 24 processors when they try to connect to another server on the LAN because all of the processors share a single adapter.

With regard to flexibility, we evaluated the breadth and variety of remote-control software, modems, communications adapters, and UPSs that were supported and certified by each vendor. If your users already use a particular remote-control software package, they probably won't want to switch. Multi-

Continues on page NE10

the out-of-band management architecture, Ethernet adapter integration, I/O bus design (16-bit or 32-bit) for connecting processors to local hard disks, and other components such as the keyboard, monitor, and floppy disk drive.

Scalability/Flexibility The communication server you choose should be able to accommodate growth. To evaluate scalability, we noted how many processor slots each product offers. When users clamor for more connections, only a minor upgrade should be required. To evaluate flexibility, we noted which

remote-control software packages, modems, adapters, and UPSs each vendor supports and certifies.

Fault tolerance Because it is the center of your communications operation, you will want your server up 7 days a week, 24 hours a day.

Here, we evaluated the features of each product that can help reduce downtime such as redundant power supplies, multiple fans, and backup hard disks. We also took hot-swap capabilities and separate power switches for each board into account.

SUITABILITY TO TASK

Management	POOR
Hardware design	FAIR
Scalability/ flexibility	GOOD
Fault tolerance	EXCELLENT

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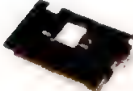


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	Token-Ring Network Adapter/A (4Mbps)	69X8138	285
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	Token-Ring Credit Card Adapter II	0933931	408
	Ethernet Credit Card Adapter II (10Base2)	0934330	225
	Ethernet Credit Card Adapter II (10BaseT)	0934331	211
	3270 Emulation Credit Card Adapter	0933315	464

Hubs, Bridges, Switches & Remote LAN Access			
	Token-Ring	8228	6091014 \$ 486
		8230*	
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		Model 2	33G4388 1,875
		Model 3	59G7719 1,975
		Model 13	59G7727 2,505
		8229 LAN Bridge (Token-Ring to Token-Ring)*	73G4761 2,622
		8235 DIALs Server for Token-Ring (Model 1)	73G3665 3,150
	Ethernet	8222	60G0625 259
		8224-Unmanaged	73G9750 822
		8224-Managed	73G9760 1,497
		8229 LAN Bridge (Token-Ring to Ethernet)*	73G4770 2,622
		8271 EtherStreamer Switch	92G8532 3,600
		8235 DIALs Server for Ethernet (Model 2)	73G3666 2,442

*Prices shown are for base units only. Required additional modules priced separately.

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Communication Servers

CONTINUED FROM NE7

Tech offers the most complete hardware solution with additional features such as a built-in modem rack, a 16-port hub, and a UPS. These features are only beneficial if you use Multi-Tech's own remote-access software, ME Host.

Finally, we looked for fault tolerance: support for fault-tolerant power supplies and hot-swapping (the ability to change processor cards while the communication server is running). Cubix and Multi-Tech both allowed the user to shut off the power in individual processor slots for easy replacement.

While each server offered interesting features, there are other issues involved in choosing a communication server—the needs of your users and the level of management desired by the network manager. Consider those factors, revisit the issue of pricing, and you'll find the communication server that's right for you.

Cubix Corp.

● Cubix ERS/FT

Our testing showed the Cubix ERS/FT to be one of the most solidly built and easy-to-install communication servers on the



SOLID AND STRONG: Cubix's ERS/FT features up to 24 processors.

market today. The ERS/FT was a strong contender for our Network Edition Editors' Choice award, but it came up a little short in the area of management.

Its management comprises BC Vision, a DOS-based utility that displays information ranging from the server's temperature to board status to blown fuses. The information is gathered via an out-of-band management system called the Intelligent Environment Sensor (IES). The IES is used to gather system information and to reboot each board when necessary. The IES constantly monitors the status of the server and can even send SNMP alarms to high-end network man-

► FACT FILE

Cubix ERS/FT

List price (tested configuration): \$23,400. **In short:** Cubix provides the ultimate fault-tolerant system in the ERS/FT, but the server's management features placed it third compared to the other servers. Excellent fault tolerance is supported by redundant power supplies and fans and a flexible platform that can support up to 24 remote-control boards. Its warning system alerts you to power failures and lets you know if the box is overheated. However, its strong design cannot make up for its lack of management features.

SUITABILITY TO TASK

Cubix Corp., 2800 Lockheed Way, Carson City, NV 89706; 702-883-7611; fax, 702-882-2407.
965 on reader service card

Management	FAIR
Hardware design	EXCELLENT
Scalability/flexibility	GOOD
Fault tolerance	EXCELLENT

agement platforms such as HP OpenView.

While BC Vision offers a lot of attractive management options such as environment status and remote reboot of processors, we found that it is lacking in NetWare integration and port status. Unlike Evergreen's management software, CAPcon, BC Vision does not offer detailed port status. (Detailed port status is the configuration information and connection status of each port.)

Also unlike CAPcon, BC Vision does not provide NLM-based management. While CAPcon provides an array of management information ranging from port status to the version of DOS running on the server, BC Vision only provides basic status information on each board such as whether a port is dead or alive.

The ERS/FT server gets a nod for its hardware design, which can accommodate up to 24 processors and has fault-tolerant features such as hot-swappable dual power supplies and fans. It has a modular power system—similar to the one found in Multi-Tech System's Multi Com Tower—that lets users control the power flow to each bank. This means that there are separate power switches for each board.

The ERS/FT is a solidly built server that is unsurpassed in its fault tolerance capabilities. If you're willing to sacrifice

Continues on page NE12

Where They Fit In

Type	Function	Selected products	Benefits	Drawbacks
Remote-node/remote-control communication servers	Provide centralized remote control and remote-node access	● Cubix ERS/FT (Cubix Corp.) ● Evergreen CAPserver (Evergreen Systems) ● J&L ChatOffice (J&L Information Systems Inc.) ● Multi-Tech Multi Com Tower (Multi-Tech Systems Inc.)	High performance, centralized management	High cost
Remote-control software	Provide remote-control access	● ReachOut Total Remote, Version 4.02 (Ocean Isle Software Inc.) ● Norton pcAnywhere (Symantec Corp.) ● Carbon Copy (Microcom Inc.)	High performance, low cost	No management
Remote-node servers	Make remote users feel as if they were part of the LAN	● LinRover (Shiva Corp.) ● AccessBuilder (3Com Corp.) ● LANexpress (Microcom Inc.)	Low cost, ease of management	Poor performance

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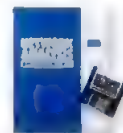
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Communication Servers

CONTINUED FROM NE10

some management functionality, Cubix provides a good overall integrated scheme for remote access.

Evergreen Systems

• Evergreen CAPserver

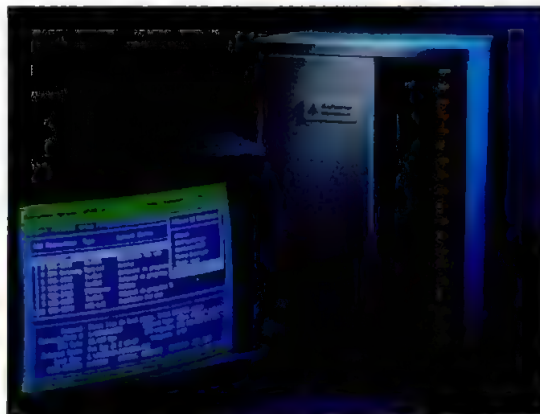
While each of the servers we tested offers a unique set of features, the Evergreen CAPserver's set is clearly the most well-rounded. The box offers the best set of management features we've seen as well as an impressive hardware platform.

During our testing, we found that the CAPserver's management, provided by the CAPcon NetWare Loadable Module (NLM), is clearly excellent. The CAPcon NLM sports a host of features,

including remote reset of boards, a remote-attachment function that allows you to connect to each processor from the NetWare console, an agent that constantly monitors the status of each board and can reset each in case of a crash, and a rich array of real-time statistics that offer valuable information regarding the status of each processor. None of the other products offer this type of Net-

Ware integration or utility.

With the CAPserver, the network administrator can dial into the NetWare server, run Rconsole (a remote-connect utility for NetWare), and control the box. This allows the administrator to reset the processors in the server remotely and reconfigure each processor board. The



FEATURE RICH: The CAPserver offers management features such as NetWare integration and remote reset of boards.

► FACT FILE

Evergreen CAPserver

List price (tested configuration): \$18,276 **In short:** Evergreen's CAPserver gives you the best of both worlds: excellent management software and a well-designed hardware platform. Evergreen has done a superb job of building a management platform that is NLM-based and works well with NetWare. However, if your network is heavy on I/O transfers, the server's 16-bit bus design could be a drawback.

*Evergreen Systems,
120 Landing Ct., Ste
A, Novato, CA 94945,
415-897-8888, fax,
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SUITABILITY TO TASK

Management **EXCELLENT**

Hardware design **GOOD**

**Scalability/
flexibility** **EXCELLENT**

Fault tolerance **POOR**

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remote-attachment feature, which is available through Rconsole, lets you remotely control the NetWare console through which you can run CAPcon. However, the utility is not perfect: It is inconvenient to use in some ways. For instance, you cannot use the Alt key when connecting to the processor boards via the console. The CAPcon NLM also lacks graphic support. Evergreen Systems plans to remedy some of these problems in its next release, Version 2.0, which is due by the end of the year.

While the CAPserver offers few fault tolerance capabilities (it does not include redundancy) and does not offer the preferred 32-bit design, it does offer the best combination of features, including a flexible design that supports up to 20 processors in a small and manageable enclosure, multiple power supplies, and Ethernet support built into each of its processor boards.

One major limitation is the CAPserver's 16-bit bus design, which can hinder performance during heavy I/O trans-

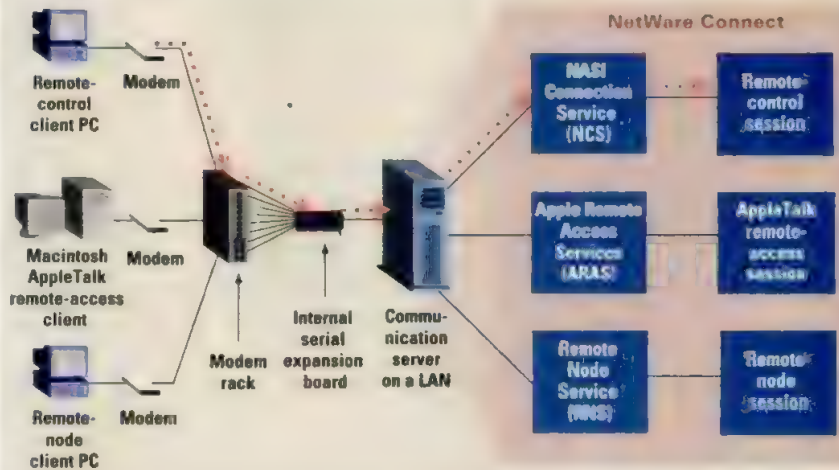
fers. If you're planning to run a lot of I/O-intensive applications such as graphics and local databases on the processor from a local drive, you might be better

off considering a 32-bit solution like the one offered by Cubix. However, if you are looking for a manageable and

Continues on page NE17

NetWare Connect: How It Works

NetWare Connect offers complete remote access: remote node, remote control, and AppleTalk remote access. The software consists of three main parts: NASI (NetWare Asynchronous Services Interface) Connection Service (NCS), Apple Remote Access Services (ARAS), and Remote Node Service (RNS).



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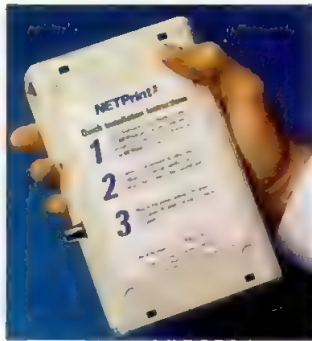
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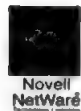
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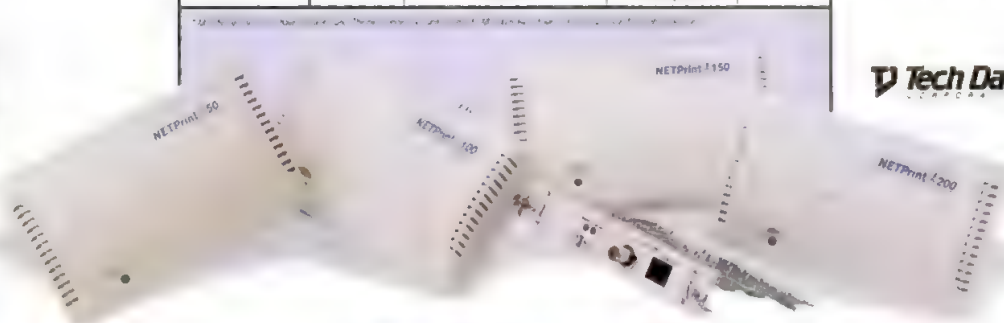
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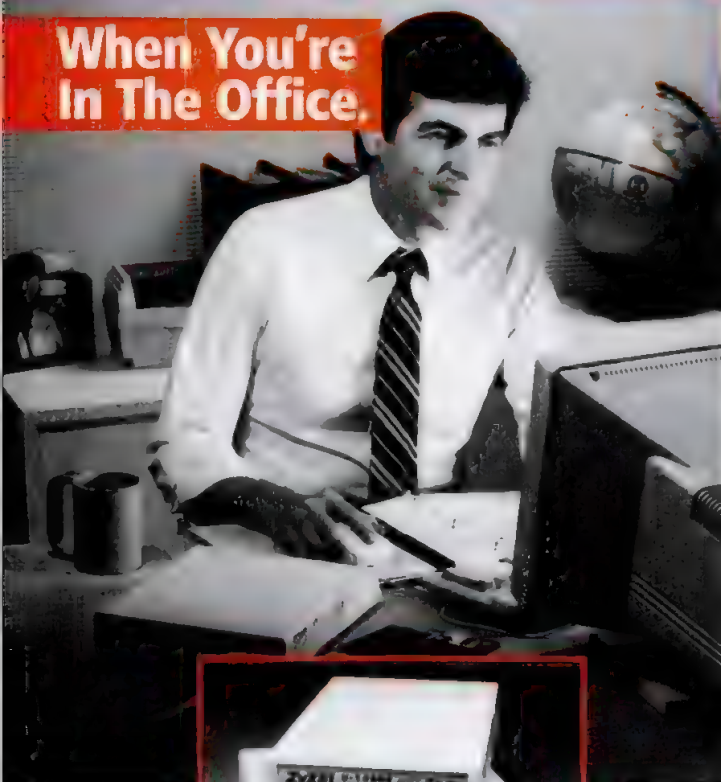
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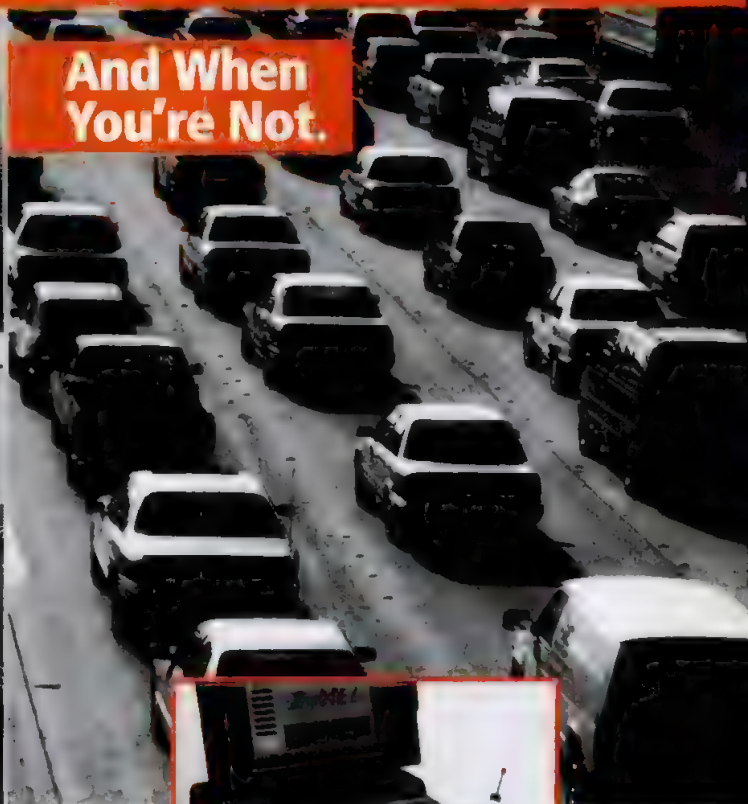
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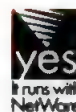
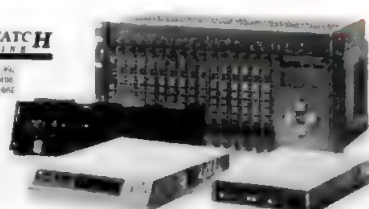
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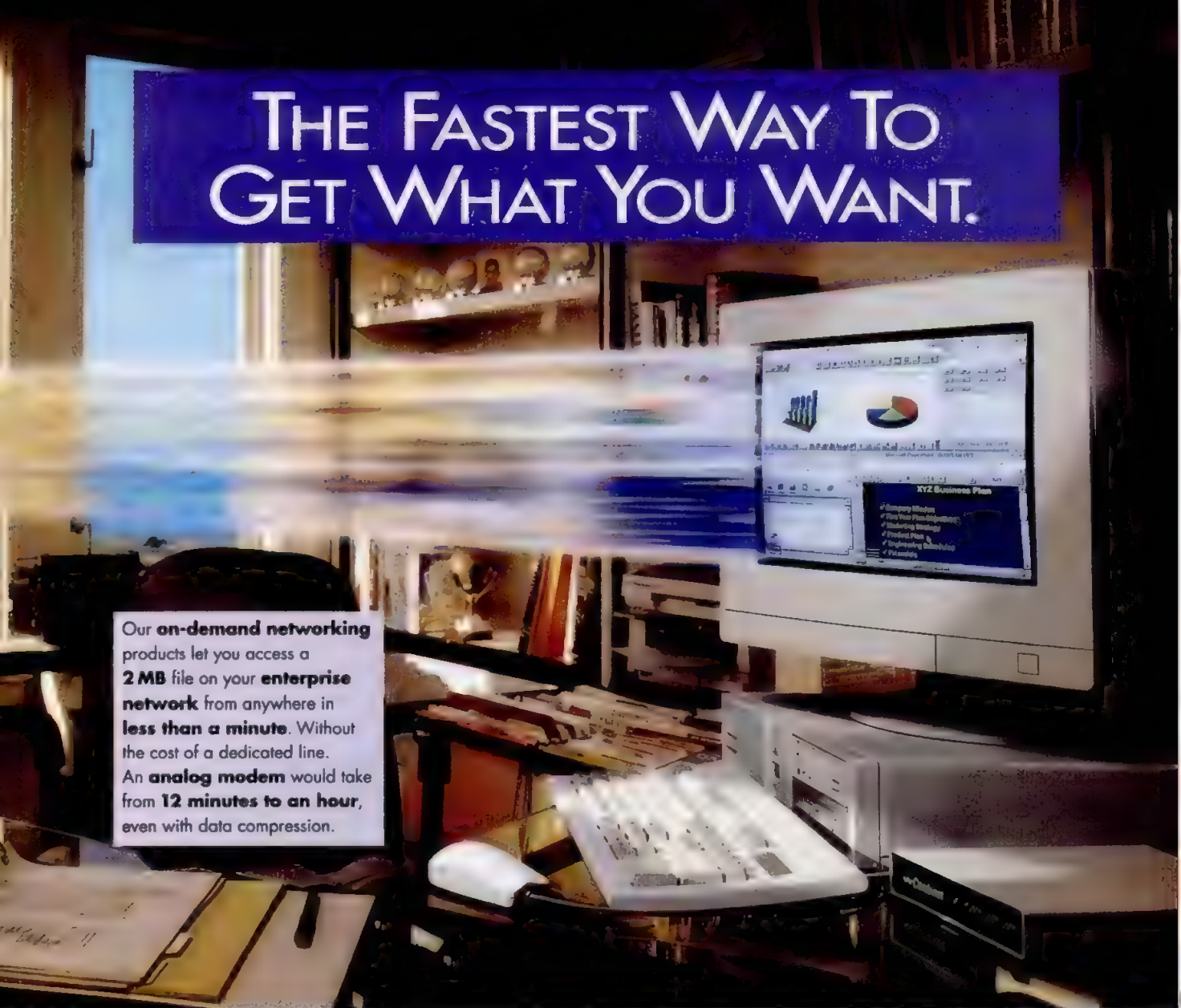


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Communication Servers

CONTINUED FROM NE13

easy-to-use communication server, the Evergreen CAPserver is certainly the best choice.

J&L Information Systems Inc.

• J&L ChatOffice

The ChatOffice offers the most interesting hardware platform of the products we tested. The server's design is very similar to that of a hub: It features a large enclosure that can house multiple processors in card form. This design is similar to that of a chassis-based hub, but in this case each card is a separate PC. Each processor is independent and features a built-in adapter and an optional hard disk. While testing, we found this design to be very effective since the ChatOffice is the only product that offers real-time hot-swapping.

The ChatOffice offers two management options. Chatlog II is an NLM-based management platform that can monitor each station's status and issue either manual or automatic resets in case of a processor crash. The other option is a plug-in module to Novell's NetWare Management System (NMS), Version 1.0, that can monitor the status of each board and send alarms to the administrator in case of problems. J&L is also working on a plug-in module for NMS, Version 2.0, the current and more widely adapted version of NMS. J&L is the



ALL IN ONE: ChatOffice's design resembles a hub housing multiple PCs.

only vendor to offer management via this plug-in module to NMS using SNMP and MIB I. The Cubix also supports

SNMP, but it does not offer the same breadth of SNMP functionality: The support is used solely to send alarms to SNMP-based applications such as NMS.

J&L's server offers little flexibility in its design, supporting only 10 processors per enclosure, but it does allow users to connect these boxes into a single workgroup. J&L's ChatOffice is one of the only products, Cubix's ERS/FT being the other, to offer redundant power supplies. MultiTech offers redundant power supplies as an option, but they are designed for the modems, not for the processor boards. Another nice hardware feature is an intelligently designed hardware switch that lets you use a single keyboard and monitor to control all the boards in the server. Cubix and Multi-Tech both offer similar functionality. Evergreen offers a software switch that lets users switch between each processor via software while sharing the same keyboard and monitor across all the processor boards.

Overall, the J&L ChatOffice offers
Continues on page NE18

▶ FACT FILE

J&L ChatOffice

List price (tested configuration): \$27,700. **In short:** J&L provides a solid platform with good management. The ChatOffice is the only product in this roundup that offers hot-swapping capabilities. It is also the only one that offers a plug-in module for Novell's NetWare Management System (NMS), Version 1.0, which allows users to manage the ChatOffice via NMS.

J&L Information
Systems Inc., 9600
Topanga Canyon
Blvd., Chatsworth
CA 91311; 818-709-
1778, fax, 818-882-
9134

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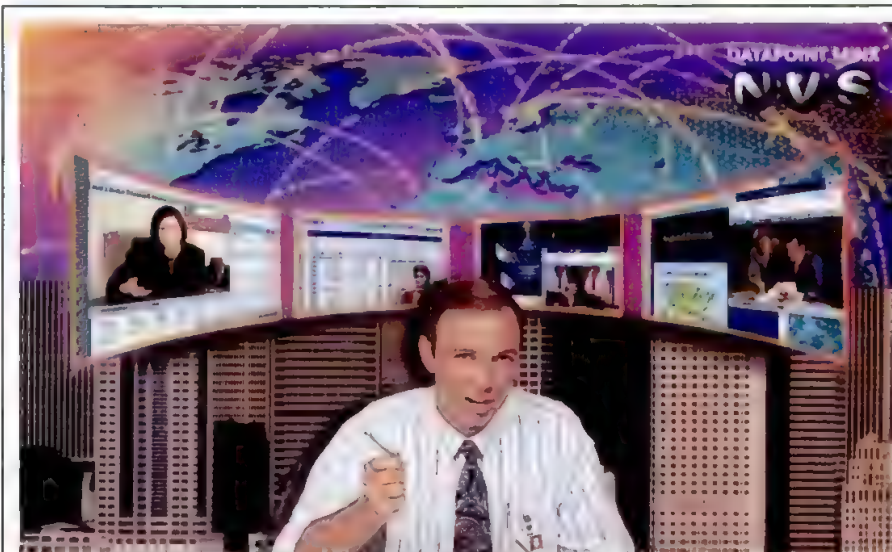
SUITABILITY TO TASK

Management GOOD

Hardware design GOOD

**Scalability/
flexibility** FAIR

Fault tolerance FAIR



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D DATAPOINT

Communication Servers

CONTINUED FROM NE17

solid management and design features—two of the most important qualities. However, you might want to think about the expense of the initial investment, considering the ChatOffice is one of the least scalable and flexible communications servers in this roundup.

Multi-Tech Systems Inc.

• Multi Com Tower

Multi-Tech's Multi Com Tower is certainly the largest communications server that we have ever seen: It's about the size of a refrigerator. When the product arrived in a crate we were a little nervous, but our apprehension subsided once we unpacked and installed it.

Perhaps the greatest drawback of the Multi Com Tower is that it lacks processor management when it is used with NetWare Connect. However, when using Multi-Tech's own remote-access software, ME Host, you can get some of the standard management features offered by the other servers, such as remote reboot of processors and automatic reset of processors in case of a crash. ME Host is similar to NetWare Connect in that it offers remote control and remote node



LARGE BUT LIMITED: The Multi Com Tower lacks management when configured with NetWare Connect.

► SUMMARY OF FEATURES

Communication Servers

Products listed in alphabetical order				
■ = YES □ = NO	Cubix ERS/FT	Evergreen CAPserver	J&J ChatOffice	Multi-Tech Multi Com Tower
List price (tested configuration)	\$23,400	\$18,276	\$27,700	\$29,400 *
Tested Configuration				
Main processor board chip,	One 486DX2/66	One 486/40 chip	One 486/33 chip	One 486/33
chip, 16MB RAM, 120MB hard disk		10MB RAM, 215MB hard disk	8MB RAM, 130MB hard disk	8MB RAM, 200MB hard
disk				
Remote-control processor boards	Three 486DX2/66 chips, 8MB RAM, 120MB hard disk	Four 486/33 chips, 10MB RAM, 215MB hard disk	Four 486/33 chips, 8MB RAM, 130MB hard disk	Three 486/33 chips, 8MB
RAM,				
disk				
NetWare, Version 3.12	■	■	■	■
NetWare Connect	■	■	■	■
8-port serial card	■	■	■	■
Ethernet adapter	■	■	■	■
Cost of Additional Equipment				
386/25, 8MB RAM, 120MB hard disk	\$1,500	\$2,090	N/A	\$1,800
486/33, 8MB RAM, 120MB hard disk	\$4,500	\$2,990	\$3,510	\$2,300
8-port serial card	\$795	\$895	\$2,095	\$599
Remote-control software	\$148	\$179	\$76	N/A
UPS	N/A	N/A	N/A	Included
Redundant power supply	\$750	N/A	\$595	N/A
Ethernet-supported hub	N/A	\$295 (8-port)	\$1,070 (12-port)	\$1,499 (16-port)
Hardware (Tested Configuration)				
Maximum number of processors supported	24	20	10	9
Supports Ethernet on each processor board	■	■	□	□
Supports hot swapping of processor boards	□	□	■	□
Bus type	ISA	ISA	ISA	ISA
Includes redundant power supplies	■	□	■	□
Includes redundant fans	■	■	□	□
Offers individual power controls for each processor board	■	■	□	■
Processor boards share one floppy disk drive	■	□	■	□
Software (Tested Configuration)				
Includes management software	■	■	■	□**
Supports SNMP	■	□	■	□
Supports NLM-based management	□	■	■	□
Can reboot boards remotely	■	■	■	■
Can reboot boards in case of crash	■	■	■	■
Supports remote management of processor boards	■	■	■	■
Supports remote-control software	■	■	■	■
Remote-node software supported	DCA RLN/2, IBM LAN Distance, NetWare Connect	NetWare Remote Node	NetWare Remote Node	Multicom RINGateway, NetWare Remote Node
Customer Support				
Warranty	1 year	2 years	1 year	2 years

and different in that it integrates its management features within ME Host.

If you decide to use NetWare Connect, you should know that your management options will be extremely limited. The server that we tested was configured with NetWare Connect and did not offer any management features beyond the basic management offered by the remote-con-

trol package ReachOut Total Remote, Version 4.02.

The hardware design of the Multi Com Tower is not flexible. In fact, the server only runs well with management if you use Multi-Tech's software. You can use software from other vendors, such as Novell's NetWare Connect, but by doing

Continues on page NE22

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Communication Servers

CONTINUED FROM NE18

so you forgo any management features that Multi-Tech has to offer.

The Multi Com Tower is a modular communications server that can be configured with or without a modem rack and UPS. The model we tested included 4

What to Look For in a Communication Server

Management capabilities

- Can automatically reset processor boards in case of a crash
- Allows manual remote reboot of each processor board
- Sends comprehensive system messages to administrator console in case of a crash
- Integrates NetWare and NetWare Connect via NLM-based management
- Supports SNMP and MIB for popular network management applications such as NMS and SunNet Manager

Hardware features

- Hot-swappable boards
- Expandable design: capable of housing several processors
- Multiple power supplies

processor boards, a 16-slot modem rack, a 16-port hub, and a UPS. Its design is similar to the one offered by Cubix: Both allow users to cut power to portions of the motherboard in order to add or remove boards to the server. However, the server lacks redundant power supplies.

Not even the server's impressive hardware design, however, can make up for its lack of management, scalability, flexibility, and fault tolerance.

O. RYAN TABIBIAN is a technical analyst for *PC Magazine Network Edition*.

▶ FACT FILE

Multi-Tech Multi Com Tower

List price (tested configuration): \$29,400 **In short:** Multi-Tech provides a well-integrated solution that includes every piece of hardware and software you need to run a communications server. While its modem-management software is impressive, the server's management as a whole is disappointing since it only offers the basic features found in the remote-control software.

SUITABILITY TO TASK

Multi-Tech Systems Inc., 2205 Wooddale Dr., Mounds View, MN 55112; 800-328-9717; fax, 612-785-9874.	Management	POOR
	Hardware design	GOOD
	Scalability/flexibility	FAIR
968 (on reader service card)	Fault tolerance	FAIR

▶ STORAGE MANAGEMENT

Palindrome HSM: Affordable and Flexible

BY STEVE RIGNEY

Palindrome HSM, Version 3.1 (\$2,995), is the latest LAN-backup system to reduce storage costs by intelligently moving unused files off the server. The new add-on for Palindrome's backup utility, Network Archivist (an Editors' Choice in our issue of September 28, 1993), is quite cost-effective. And while installing the complete system may take a while, it is well worth the effort.

HSM (hierarchical storage management) is a new technology to the world of PC LANs that can save you thousands of dollars in storage costs by moving seldom-used files off your file servers and onto less expensive, secondary storage media, such as optical disks or DATs.

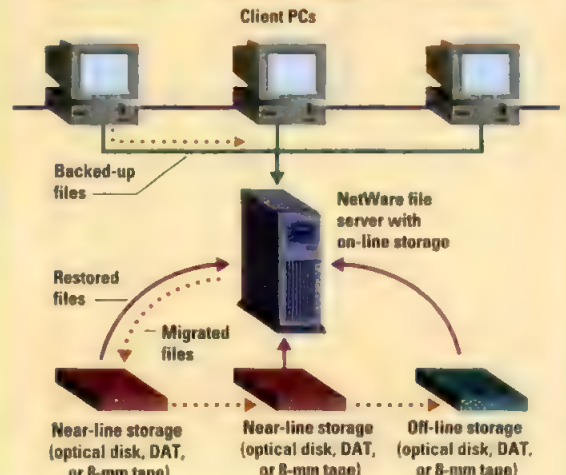
The latest addition to Palindrome's line of backup utilities extends the basic HSM features of Network Archivist 3.0 (see "Palindrome's Network Archivist Now Offers HSM," October 26, 1993), adding automatic file retrieval and providing multiple layers of storage—two features required by a full-fledged HSM system.

This kind of functionality can already be found in the first HSM product for NetWare on the market: Conner Peripherals' Conner HSM (see "Conner HSM Safeguards Your Data," September 28, 1993). So what unique advantages does Palindrome HSM offer?

First, it is considerably less expensive: Even including the cost of a multiple server license of Network Archivist (\$2,895), the total cost of Palindrome HSM is less than \$6,000—more than \$1,500 less than that of Conner HSM (\$7,500). Neither product's price includes hardware.

Just the fact that Palindrome HSM doesn't require a dedicated server can save you money. Even though it uses NLMs to control and migrate files, the product can run on a dedicated PC with a less-expensive runtime version of Net-

Multiple Storage Levels



Palindrome HSM works with Network Archivist to back up all clients and servers and to move seldom-used files to less expensive media.

Ware installed. Conner HSM must run on a dedicated server, and that adds to the cost.

Palindrome's product is also more flexible because it allows you to use any type of media for storing migrated files. Conner, on the other hand, uses a rigid three-tier approach: files are moved from mirrored hard disk to optical disk and, finally, to tape.

Continues on page NE24

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Palindrome

CONTINUED FROM NE22

THE TECHNOLOGY

Hierarchical storage management, which was originally developed for mainframes and midrange computers, can help you reduce the costs of data storage and administration by using less expensive storage media. The files you move will still be accessible to your users; retrieving them may just take a little longer than normal. With Palindrome HSM, you can also move files to removable media, or off-line storage, which can then be stored in a secure location, such as a safe.

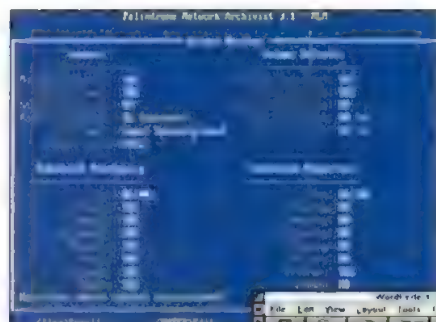
The most important feature of any HSM system is the ability to retrieve a file without the user knowing it no longer resides on their hard disk. Conner and Palindrome both place a file marker on the server's hard disk when a file is moved, so users still see their files and can request them as per usual. The HSM system does all the work by taking those requests and automatically retrieving the migrated files.

If a file has been moved to a significantly slower media, such as an 8-mm tape, retrieval times can increase significantly. In those cases, both Conner and Palindrome utilize client TSRs that notify users that a migrated file is being retrieved. Conner's TSR is optional, but Palindrome's is required to retrieve files. However, it is only 11K and offers users the option of canceling a retrieval. Conner's TSR offers no cancel option during file retrievals.

DOING HSM DIFFERENTLY

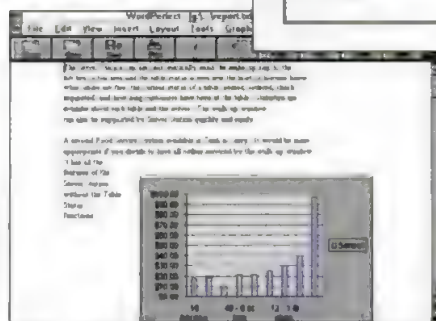
Palindrome HSM differs slightly from Conner HSM in the way it categorizes storage levels. It provides three levels of storage: *on-line*, *near-line*, and *off-line* storage. On-line storage comprises files that reside on your server's hard disk. These files are immediately accessible, protected by frequent backups (because of the integration with Network Archivist), and pre-staged, which means that they have been selected for migration. On-line storage on Conner HSM resides on a mirrored hard disk, so it is equally accessible.

Near-line storage comprises files that are migrated to a variety of secondary media types, including optical jukeboxes, DAT, and 8-mm tape drives, as well as several types of tape autoloaders. Conner's optical and tape storage levels both fall under the category of near-line storage. Both Palindrome and Conner provide support for as many levels of near-line storage as you require.



NEARLY TRANSPARENT:

Once a file is migrated off the server, Palindrome HSM notifies users of delays in retrieval, then recalls that file for them.



Off-line storage is migrated to removable media, such as a DAT, so that it can be stored in a safe or off-site or in something equally secure. Conner HSM does not support off-line storage.

Like Conner, Palindrome utilizes a system of watermarks to determine when files should be migrated. These watermarks reflect the percentage of disk space currently occupied on the server. For example, we selected a high watermark of 90 percent and a low mark of 80 percent. When the disk was filled to the 90 percent level, Palindrome HSM moved files off the disk until the mark was back below the 80 percent level.

Watermarks aren't your only option,

however. You can also manually select specific files for migration based on criteria such as the date last accessed, file size, and file type.

LEAVE A DAY FOR SETUP

Before you plan on installing either Palindrome's or Conner's HSM solution, set aside a full day for reading your manuals and taking notes. Both of these products are confusing to install, but they perform well when you finally get them up and running. With Palindrome, the most time-consuming portion of the installation was the setup of Network Archivist.

We loaded the software on our NetWare 3.11 server and connected a Palindrome Fast 5000C tape autoloader that uses 108-mm tapes. We dedicated five of the tapes to Network Archivist nightly backups and the other five to Palindrome HSM. During the day, old files were migrated from our server to our autoloader and

we saw no noticeable effects on the server's performance during the migration. At night, the same autoloader was used for an unattended tape backup, so you can use Palindrome HSM with a single storage device for all your backup and HSM needs.

Simply put, Palindrome HSM is a highly effective method for preserving both hard disk space and valuable (if underused) files. The package's integration with Network Archivist provides a complete backup and storage management scheme for NetWare LANs. If you are already using another backup utility, such as Cheyenne's ARCserve, and you don't want to switch to Network Archivist, you might want to go with Conner. Just remember: You can buy Palindrome HSM and Network Archivist for less than you will spend for Conner HSM.

► **Palindrome HSM, Version 3.1.** List price: \$2,995. Palindrome Corp., 600 East Diehl Rd., Naperville, IL 60563; 708-505-3300; fax, 708-505-7919.

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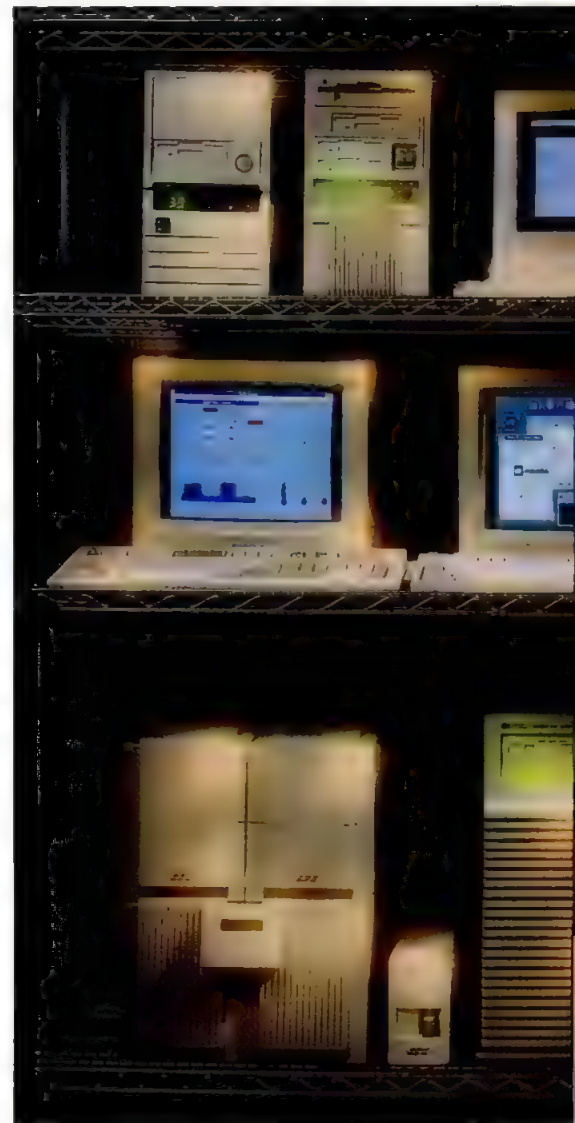
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► WIRELESS NETWORKS

Token-Ring Access via Radio

BY STEVE RIGNEY

Persoft's new Intersect Concentrator: Token-Ring, Version 1.0, (\$4,995) gives Token-Ring users something they've never had before: a practical way to connect wireless clients to a wired LAN. Unlike previous solutions, which used infrared technology, this spread-spectrum radio Token-Ring bridge is affordable and easy to install. It also provides reasonably good performance as long as you are just transferring small files and sending e-mail.

The Intersect Concentrator is a PC-sized box that comes with a 4-/16-Mbps Token-Ring adapter, an AT&T Global Information Solutions WaveLAN wire-

less adapter, and a 2,400-bps internal modem. Persoft recommends using up to 10 nodes per wireless network. We agree. The nodes must be located no more than 800 feet away from the bridge, and connections can support a maximum throughput of 2 Mbps.

Wireless adapters for connecting clients to the Intersect Concentrator are not included: You'll need to buy them separately. Intersect can work with any wireless adapter compatible with WaveLAN that uses frequencies from 902 MHz to 928

MHz and utilizes *direct sequencing*. Direct sequencing is a method for signalling over the entire frequency range rather than one frequency at a time, as *frequency hopping* products do.

As a bridge, the Intersect Concentrator can work with any major network operating system, including NetWare and Windows NT Advanced Server. It also supports the Spanning Tree Protocol, which allows for redundant network paths between locations.

Because the Intersect Concentrator forwards packets unintelligently, like a bridge, broadcasts (information sent to all nodes) could bring the wireless network to a halt. Persoft preserves the wireless bandwidth by allowing you to configure the Intersect Concentrator to filter out



RADIO STATION:
The Intersect Concentrator is the first spread-spectrum Token-Ring bridge.

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unwanted traffic, such as Server Advertising Protocol (SAP) broadcasts. You can filter packets based on protocol or either the destination or source network address. We took advantage of the address filtering to establish separate wireless networks, each on its own Intersect Concentrator. This not only provided more bandwidth for each network, but it added a measure of security because the different networks could not access each other's data. The filters are easy to set up, and some are included with the configuration software.

Although not directly comparable, Ethernet wireless products serve as a good reference point for the Intersect Concentrator: Proxim's RangeLAN2, Xircom's NetWave, and most other Ethernet wireless products utilize *access points* to connect wireless clients to a wired LAN. While these access points can eliminate some unnecessary traffic, they do not offer the filtering capabilities and protocol independence of a wireless bridge.

The Intersect Concentrator is very

► FACT FILE

Intersect Concentrator: Token-Ring, Version 1.0

List price \$4,995. In short: Persoft's Intersect Concentrator: Token-Ring is the first spread-spectrum wireless Token-Ring bridge on the market. It can operate with all major network operating systems. It is affordable, relatively easy to install and configure, and offers high enough throughput for transferring small files and sending e-mail.

Persoft Inc., 465 Science Dr., P.O. Box 44953, Madison, WI 53744, 608-273-6000, fax, 608-273-8227

962 on reader service card

easy to set up—if you know Token-Ring technology. We installed it in less than an hour, but it may take a while longer if you're not thoroughly familiar with Token-Ring bridges, ring and network IDs, and source routing. Fortunately, Persoft provides excellent documentation, and the configuration software is easy to use.

To configure the device, we connected a serial cable to the back of the chassis and established a DEC VT220 terminal

session using the included software. We configured the Intersect Concentrator locally through this direct serial connection, but you can also dial in remotely via the 2,400-bps modem (which is slow by today's standards, but sufficient for configuring the unit).

We connected the Intersect Concentrator to our NetWare 3.11 wired 4-Mbps Token-Ring LAN via Type 1 IBM cable (shielded twisted-pair wire with a 9-pin connector). We transferred several binary files from a wired client to our wireless clients, each of which took roughly twice the time to transfer as they did on the wired network. We also ran WordPerfect for Windows and several other server-based applications on the wireless clients, but the performance over the 2-Mbps wireless link was painfully slow.

If you need to connect wireless clients to a Token-Ring LAN, look no further than the Intersect Concentrator. It won't support heavy traffic loads, but it provides the wireless solution that many Token-Ring users have been waiting for.

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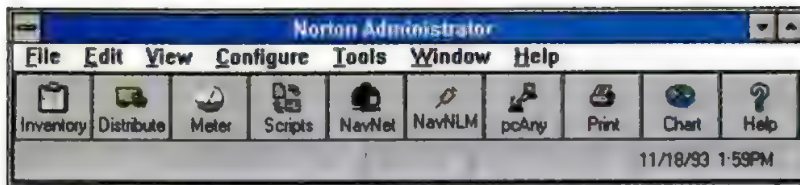


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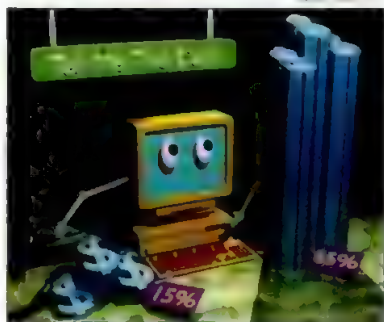
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► NETWORK MANAGEMENT

Proxy Server Host: No-Frills Windows

BY PADRAIC BOYLE

Funk Software's Proxy Server Host sounds like a great idea: a Windows-based alternative to NetWare's Rconsole that lets you monitor and control NetWare servers from any Windows-based PC. But a Windows .PIF file for Rconsole is nearly as effective.

Proxy Server Host is a new extension to Funk's Proxy remote-control software, with which it is included. Proxy allows network administrators to take control of network clients from a central PC. It simplifies troubleshooting and allows the manager to run CPU-intensive tasks on idle clients. Proxy Server Host extends remote control to the servers so that you can monitor them



NOT QUITE GUI: Proxy Server Host lets you run NetWare server utilities under Windows.

from any Windows client without exiting Windows or creating a .PIF for Rconsole. One server license is included with Proxy; additional licenses are available.

Proxy uses a *master/host* system in which a *master* PC can control any client or server running *host* software. Instead

of the host TSR that runs on clients, Proxy Server Host runs as an NLM on the server. After launching Proxy, you reach a DOS prompt, from which you can run NetWare utilities to monitor and configure your servers—just like Rconsole.

The product provides all the features of Rconsole with a few advantages. Proxy Server Host allows you to control multiple servers simultaneously, while Rconsole lets you control only one server at a time. Proxy Server Host also lets you use Windows' cut-and-paste functions.

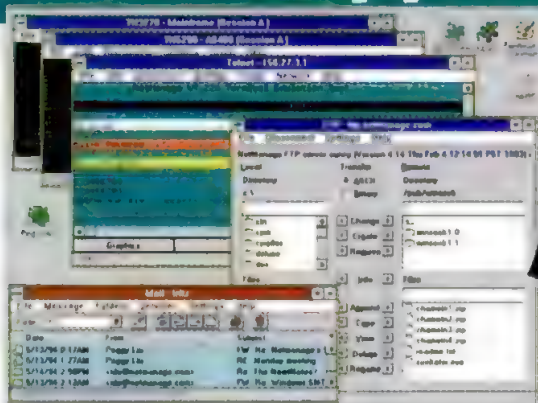
We installed the program in minutes, but it doesn't automatically discover each server's network address, so we had to enter them manually, which took a while.

If you use Proxy on your network, you'll love Proxy Server Host. If not, you may be better off writing that .PIF: It's cheaper.

► **Proxy Server Host.** List price: \$395 to \$3,750; additional server licenses, \$145. Funk Software Inc., 222 Third St., Cambridge, MA 02142; 617-497-6339; fax, 617-547-1031.

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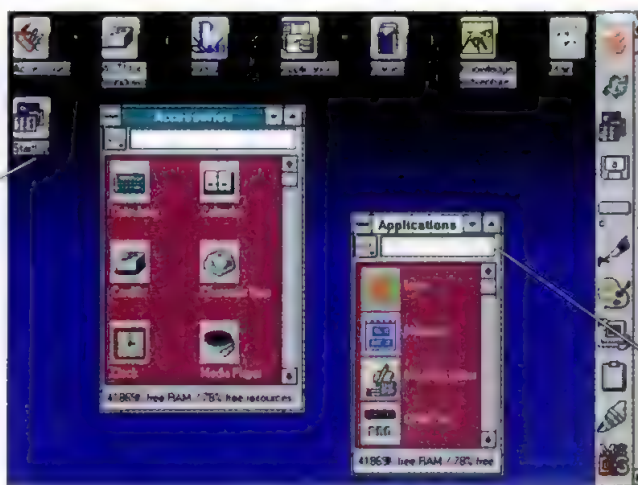
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idea incorporated in Microsoft Office, but we've taken it to its obvious conclusion.

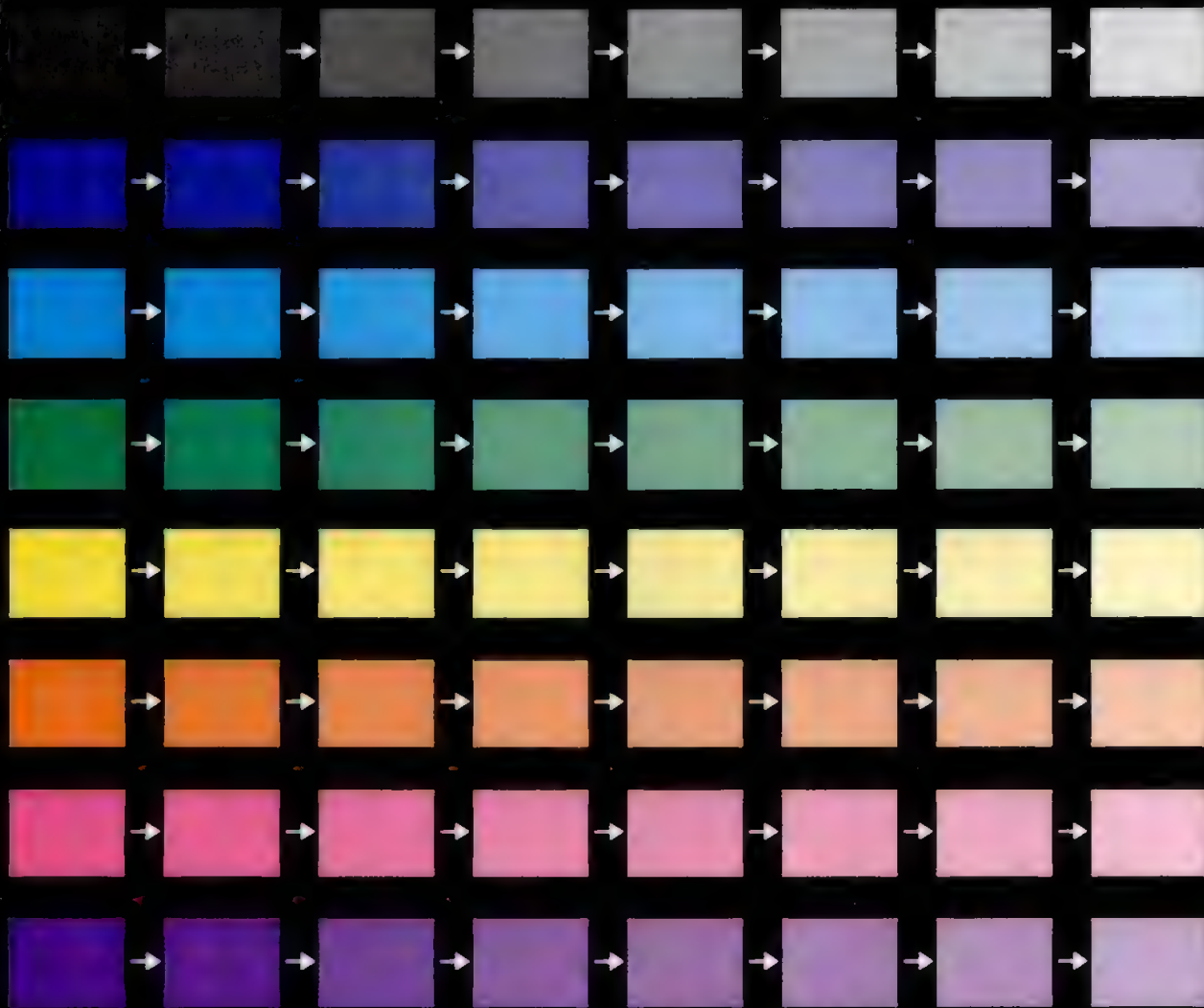
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► VIRUS PROTECTION

Changing the Rules on Viruses

BY JAMES KARNEY

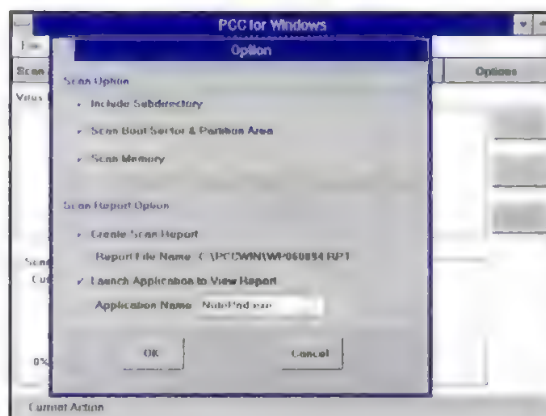
Viruses are the bane of a network administrator's existence, and the new breed of polymorphic viruses is the most dreaded of all. But with PC Rx, Version 4.0, network managers can gain the upper hand. The newest version of this virus checker from Trend Micro Devices is one of the first products to defeat viruses without requiring an update every time a new strain is discovered. While this standalone application requires you to have a copy for each machine, we found it effective for examining and repairing most viruses on both local and network volumes. PC Rx is not a surefire defense against polymorphic viruses, however.

Unlike most of its competitors, the \$69 PC Rx uses only a series of predefined rules to monitor viruslike activity, such as redirection of DOS interrupts (where the virus intercepts calls to the CPU and interferes with or changes them) and replication activity (where the virus copies itself onto other drives, including floppy disks and network volumes). This system eliminates the need for updates, since the product does not rely on previously known virus signatures. Most other antivirus products either scan drives for virus signatures or use checksum testing, which detects changes in a disk's boot sector. Because these products rely on signatures or documented patterns of behavior, they require constant updates to counteract the latest known virus strains.

According to the company, this rules-based method can also be effective against polymorphic, also called *mutation-engine*, viruses. This relatively new and extremely dangerous type of virus can alter its own appearance and behavior, making it much more difficult to detect and eradicate. PC Rx includes a feature called MutieClean that is designed specifically for combating mutation-engine viruses: It's a software

routine that emulates CPU activity to trigger mutation-engine viruses, which are then contained and removed. But when we tested the MutieClean feature with a strain of the Trident polymorphic virus, PC Rx was unable to detect its presence, and the virus caused our system to lock up.

PC Rx offers two modes for conducting virus checks on clients: either continu-



NOTHING FANCY: PC Rx's simple Windows interface makes it easy to customize virus scans and generate reports.

ously as a 9K TSR or at specific times by running the full application. Servers, on the other hand, can only be checked by running the application. You can also use PC Rx to create a recovery disk that contains a copy of your DOS boot sector and drive partition tables.

The PC Rx package includes both

DOS and Microsoft Windows versions of the software, each of which is on a single disk (although they are confusingly labelled "one of two" and "two of two" though you only need one or the other of them). Both interfaces are intuitive and very well designed.

We installed PC Rx on a Microsoft Windows for Workgroups client that was part of our NetWare 3.12 LAN. We deliberately infected the client with a recent strain of the Form virus, which infects the boot sector of a hard disk and replicates itself onto other available drives. We chose Form because it is fairly common

and is easily passed via floppy disk transfers between computers—an everyday occurrence on a typical LAN.

During installation, we immediately discovered that PC Rx was effective, although it gave rather ambiguous advice for removing the virus it detected. At the time of installation, PC Rx first checked to ensure that the system was virus-free before continuing the installation. It quickly located the Form strain on our hard disk, but when it notified us of the fact, it suggested we launch a

virus-removal utility before resuming the installation and made no mention of Part, the virus-removal utility included with PC Rx. Nonetheless, Part successfully removed the virus and completed the installation without a hitch.

Once we had both versions of the program installed, we found both versions of the software easy to use. Under Windows, virus checks can be performed in the background. During a scan, a status report provided information on the file currently being scanned, the total number of files scanned, and any viruses that have been detected. We had no difficulty scanning a 1GB local drive and a 4GB NetWare volume as a background task while we ran Microsoft Word in the foreground.

PC Rx is an effective tool for keeping your servers and your clients virus-free, but it doesn't continuously scan servers and it doesn't detect all polymorphic viruses.

► FACT FILE

PC Rx, Version 4.0

List price: \$69. **In short:** PC Rx uses a series of rules to identify viruses based on their behavior, rather than their signature, and can remain effective without updates. It includes both DOS and Windows versions and a utility called Part for removing viruses. PC Rx isn't a network application, so a copy is required for each machine. It is an effective antivirus defense for both client and server hard disks but is not 100 percent effective against polymorphic viruses.

Trend Micro Devices Inc., 2421 West 205th St., Suite D-100, Torrance, CA 90501; 800-228-5651, 310-782-8190; fax, 310-328-5892.

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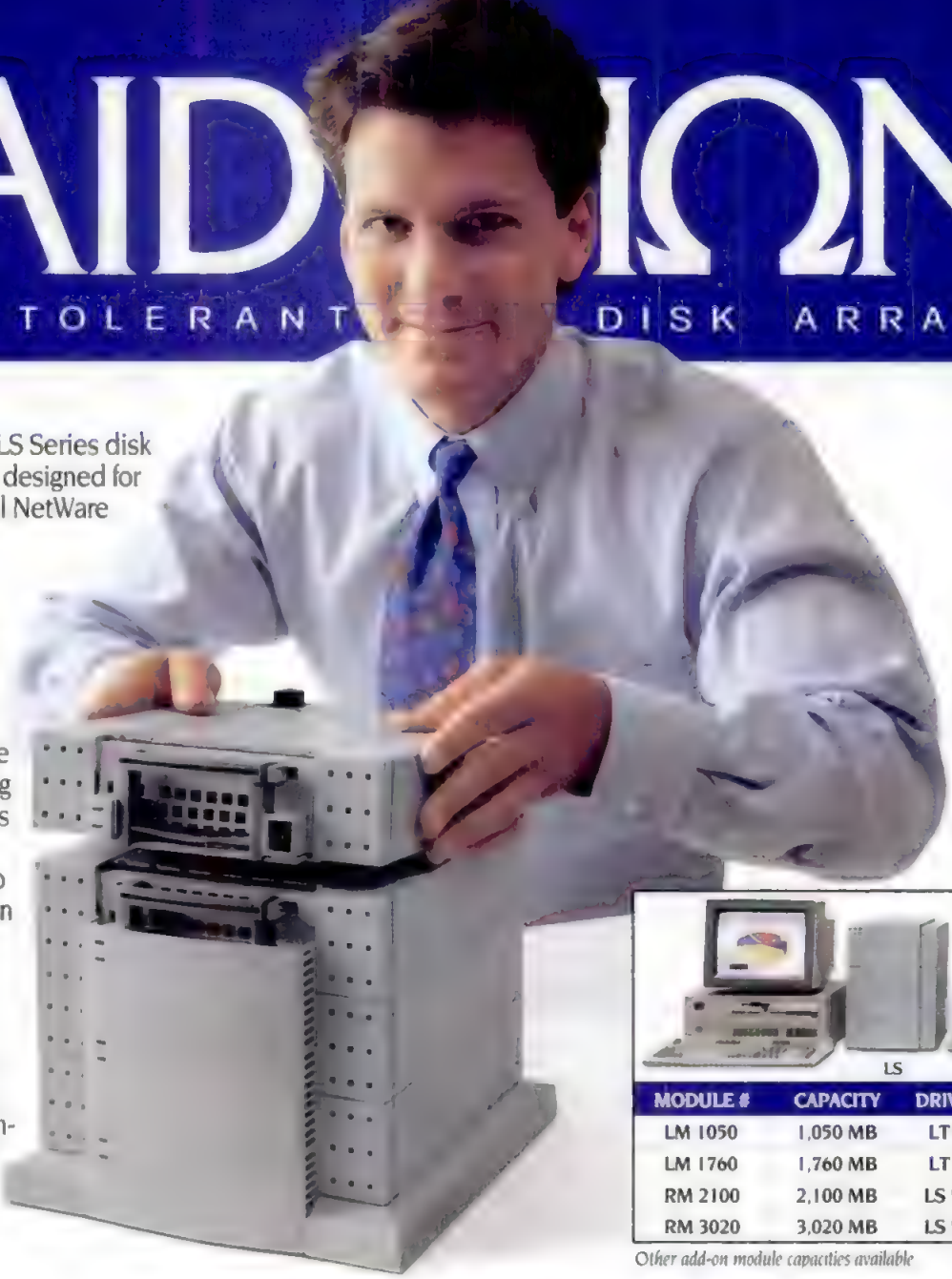
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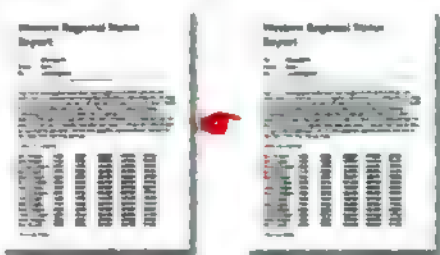
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**Network
Edition****NEW & IMPROVED**

News of announced network products and upgrades

By Vicki B. Jacobson

NEW

It's More Than Just a Hub—Again

In a joint venture to develop products for shared environments, **SynOptics Communications** is combining its expertise in network monitoring and analysis with **Network General Corp.**'s expertise in troubleshooting and analysis. The result: a probe for SynOptics' Lattis System 2000, 3000, and 5000 hubs.

Part of the agreement calls for SynOptics to develop a line of Advanced Analyzer agents for its line of hubs based on Network General's Distributed Sniffer System (DSS) analyzer. The agents (available as a software upgrade or integrated into SynOptics' hubs or hub modules) gather and analyze information on Ethernet and Token-Ring networks down to the port level.

The agents also feature remote monitoring (RMON) capabilities and can be managed via Optivity, SynOptics' network management system. The software will be included in the upcoming release of Optivity—Version 5.0—along with an additional subset of Network General's DSS.

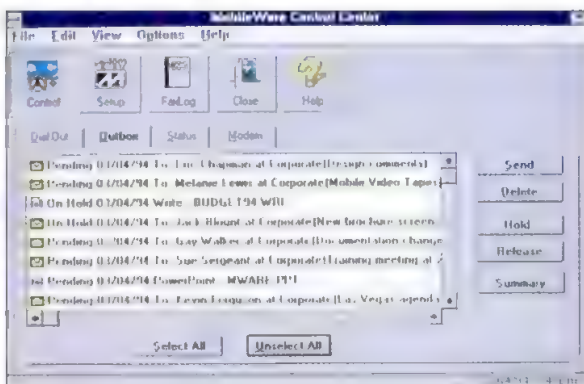
► **Advanced Analyzer, Version 1.1.** List price: *Available free as an upgrade.* SynOptics Communications Inc., 4401 Great America Pkwy., P.O. Box 58185, Santa Clara, CA 95052-8185; 408-988-2400; fax, 408-988-5525.
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NEW

MobileWare Keeps Remote Users Connected

Mobile users are never far from the corporate LAN when they use **MobileWare Corp.**'s MobileWare, Version 1.0. The software uses a wireless or telephone-line connection to send and receive e-mail (via cc:Mail), faxes, and files to and from the server back at the office. MobileWare uses a store-and-forward architecture to access the corporate LAN: If a connection is not available (when you're on a plane, for example), the software stores the request. Once a connection is available, MobileWare passes along the request. Also, if you've been disconnected for some reason, it reestablishes the connection itself. MobileWare is an alternative to such remote-access solutions as remote-control and remote-node software, which are session-based and require a continuous connection for transmissions.

► **MobileWare, Version 1.0.** List price: \$280. MobileWare Corp., 2425 North Central Expy., #1001, Dallas, TX 75080-2748; 214-952-1200; fax, 214-690-6185.
Circle 953 on reader service card



PLEASE HOLD: MobileWare allows users to view current actions and communication links.

HOT PROSPECT

Artisoft Capitalizes On 32-Bit OS



Artisoft's CorStream allows users to combine the functions of a peer-to-peer NOS with the power of NetWare. CorStream is a dedicated server that can be integrated into the LANtastic environment while providing the power and performance of a 32-bit platform.

CorStream runs as a NetWare Loadable Module with a runtime version of NetWare 4.01. With Version 5.0 and 6.0 of LANtastic, the server preserves the ease of use of LANtastic while adding NetWare's multitasking performance, fault tolerance, and file compression/media management capabilities.

CorStream's fault tolerance capabilities include disk mirroring and disk duplexing. The CorStream server also supports a variety of storage devices, including CD-ROM drives, WORMs (write once, read many), and jukeboxes.

► **CorStream.** List price: \$949 (5-user standalone version). CorStream dedicated server and LANtastic, Version 6.0, client software; 5-user version, \$1,149. Artisoft Inc., 2202 N. Forbes Blvd., Ruscon, AZ 85745; 602-670-7100; fax, 602-670-7101.

Circle 951 on reader service card

NEW

Let Your Computer Take a Message

Modems are more than just a means of transferring files; at least, the Home Office 144i is. This new modem from **Prometheus Products** integrates data and fax communications with voice capabilities. The voice capabilities allow a user to turn a computer into a telephone answering machine.

Users can also send faxes from within Windows, resend faxes or pages, and view multiple fax images simultaneously. Using V.42bis data compression, users can boost throughput from 14.4 Kbps to 57.6 Kbps.

Voice messaging is accomplished with Prometheus's MaxFax, Version 2.5, voice software. Users can design their own voice mail system using MaxFax so that their PCs will answer calls, play personal greetings, and save messages in files in voice mailboxes.

► **Home Office 144i.** List price: \$189. Prometheus Products Inc., 9524 SW Sherwood Rd., Tualatin, OR 97062; 503-692-9600.

Circle 954 on reader service card

NEW

Olicom Boosts PC and Server Throughput

Olicom USA brings the power of ATM to your desktop with its ATM EISA Card. The 155-Mbps SONET (an ATM interface used to transmit ATM cells) multimedia fiber adapter card allows users to implement bandwidth-intensive applications such as videoconferencing. The card can also be installed in a server, providing a connection between LANs and an ATM backbone.

Olicom also announced 25-Mbps and 51-Mbps adapters that will support the ISA, EISA, PCI, and PCMCIA architectures. All of the products will be available by the beginning of 1995.

► **Olicom ATM EISA Card.** List price: *Pricing to be announced.* Olicom USA Inc., 900 East Park Blvd., #180, Plano, TX 75074; 214-423-7560; fax, 214-423-7261.

Circle 955 on reader service card

NEW

MicroConnect: Small Yet Strong

Even in bridging, *better* is associated with *smaller* and *faster*. **Acsys** cashes in on this association with MicroConnect, its miniature 14,880 packet-per-second local bridge (4.25 by 1.9 by 0.9 inches). Designed for small workgroup environments, MicroConnect can accommodate up to 256 users.

The plug-and-play, two-port Ethernet bridge is an external device that connects directly to a hub's AUI port. The bridge

can be purchased either as a standalone product or with Acsys's MicroStack Ethernet hubs and 10BaseT transceiver for a complete workgroup solution.

► **MicroConnect.**

List price: \$499; *workgroup bundle*, \$2,137. Acsys Inc., 7 Oak Park, Bedford, MA 01730; 617-275-4455; fax, 617-275-0723.

Circle 956 on reader service card



LOW

MAINTENANCE: Plug

Acsys's MicroConnect into a hub's AUI port, and it's ready to go. This local bridge can accommodate up to 256 users.

BRIEFS

MODEMS

U.S. Robotics reduced pricing on its line of Courier V.32 turbo modems. Courier V.32 turbo is \$475 down from \$695, Courier V.32 turbo/PC dropped from \$645 to \$435, Courier V.32 turbo Fax now lists for \$495 down from \$795, and Courier V.32 turbo Fax/PC is down to \$455 from \$745. 800-342-5877.

Practical Peripherals also reduced pricing on its line of high-speed data and fax ProClass modems by up to \$110. Reductions include the ProClass PC 288MT V.FC, which now lists for \$349 (originally \$459) and the ProClass PC144MT, which now lists for \$199 (down from \$259). 805-497-4774.

BayTech's new PS-4 server (\$595 to \$895) offers simultaneous modem and printer capabilities. The modem/print server accommodates both remote and local users with its dial-in and dial-out features. As a print server, PS-4 supports up to 32 queues over 32 file servers. 800-523-2702; fax, 601-467-4551.

BACKUP

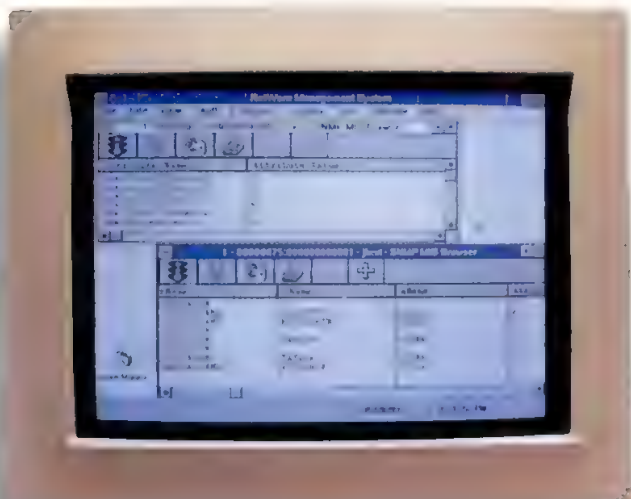
Mountain Network Solutions added client support to the new version of its backup and recovery product, FileSafe for Windows Rescue NLM. Version 1.1 (\$499) features automated backup protection with its automatic setup feature. 408-438-6650; fax, 408-461-3047.

Arcada Software links NetWare and Microsoft Windows NT environments, allowing users to back up and move data between the platforms. The new addition to the Backup Exec line, Backup Exec for NetWare, Enterprise Edition (\$995), supports DOS, Windows, Macintosh, and OS/2 systems. 407-262-8000.

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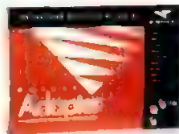
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Features	Conner CR6-RAID	Mirroring/Duplexing
Fault tolerant capacity	5.0 GB	5.0 GB
User definable rebuild	YES	NO
Includes SCSI host adapter and cable	YES	NO
Remote Array Management GUI	YES	NO
Hot spare capable	YES	NO
Hot swap drives	YES	NO
List price	\$10,995	\$14,500
Cost per MB	\$2.19	\$2.90

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Features	Conner CR6-RAID	Storage Dimensions Continua	Micropolis Raidion LT
Bootable (does not require separate boot device)	✓	✓	
Hot spare	✓		✓
User definable rebuild	✓		
Windows NT certified	✓		✓
Includes SCSI host adapter and cable	✓		
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CIRCLE 948 ON READER SERVICE CARD

NEW

Z-Code Offers Cross-Platform E-Mail System

Based on Internet-standard networking and messaging protocols, **Z-Code Software** (a division of Network Computing Devices) brings its Unix e-mail software to the Windows and Macintosh environments.

Z-Code's Z-Mail differs from traditional PC LAN-based e-mail systems in two ways. First, mail isn't passed through a gateway to get from one platform to another or to go through the Internet. Instead, the flow relies on Unix mail-transport and routing features.

Second, Z-Mail bypasses proprietary LAN-based protocols and opts for Internet protocols such as the Simple Mail Transport Protocol (SMTP) which is the TCP/IP protocol for sending e-mail and Multipurpose Internet Mail Extensions (MIME), an Internet e-mail specification for sending multimedia messages.

► **Z-Mail for Windows.** List price: \$295. **Z-Mail for Macintosh.** List price: \$295. Z-Code Software Corp., 101 Rowland Way, #300, Novato, CA 94945; 415-898-8649.

Circle 957 on reader service card

IMPROVED

Funk Eases Application Metering

Version 1.1 of **Funk Software's** AppMeter software-metering application is easier to install and supports application suite-metering. The company also announced Oversight, an add-on package for AppMeter, which generates reports about software usage on all file servers running AppMeter. The reports are based on the information gathered from AppMeter.

```

History Report by Application
Start date: 3/24/94 End date: 3/25/94

App      Limit  Inferred  OK  Denied  GFI  Max Concurrent  % of Limit
-----
LEGION   1      0      0      0      0      1 / 100%
AMPIED   1      0      0      0      0      1 / 100%
BOMBS    1      0      0      0      0      1 / 100%
BOMB POWER 1      0      0      0      0      1 / 100%
JENCKL   1      0      0      0      0      1 / 100%
KIDNAPING 1      0      0      0      0      1 / 100%
MMA      1      0      0      0      0      1 / 100%
TOXICITY 1      0      0      0      0      1 / 100%
UTAHN    1      0      0      0      0      1 / 100%
WFO      1      0      0      0      0      1 / 100%

```

APP POLICE: AppMeter, from Funk Software, monitors and manages your network applications.

Hoping to ease the network manager's burden, Funk designed AppMeter, Version 1.1, so it can be configured from a central site. Also, AppMeter now monitors suite licenses. The software collects information regarding single versus suite licensing, allowing network managers to make cost-effective purchasing choices.

► **AppMeter, Version 1.1.** List price: \$595 per server, free as an upgrade. **Oversight.** List price: \$695 per server. Funk Software Inc., 222 Third St., Cambridge, MA 02142; 617-497-6339.

Circle 959 on reader service card

IMPROVED

Shany Broadens Scope of Management App

Shany takes a proactive role in network management with its latest release of AlertView. In addition to detecting and reporting application problems, AlertView, Version 2.3, features the ability to correct and prevent them: Users can now program automatic correction procedures. Other new features include support for Banyan VINES/IPck and Novell LAN Workplace, a new user interface, and remote power on/off capabilities.

► **AlertView, Version 2.3.** List price: \$935 (10-node package). Shany Inc., 1101 San Antonio Rd., Mountain View, CA 94043; 415-694-7410; fax, 415-694-4728.

Circle 958 on reader service card

BRIEFS

Hubs

Olicom doubles the previous port capacity of its line of Token-Ring stackable hubs. The 20-port CAM (\$3,395), the company's latest Controlled Attachment Module (CAM), costs \$170 per port. The CAM combines the functions of a Controlled Access Unit (CAU) with those of a Lobe Attachment Module (LAM). The CAM has the ability to connect as many as 20 workstations and can also support up to two LAMs for a total of 60 ports. 214-423-7560; fax, 214-423-7261.

Klever Computers introduced 16- and 32-port stackable hubs that were designed for departmental networks while reducing pricing on its high-end managed and low-end unmanaged hubs. The KleverHUB Model K1016 (\$895) and the KleverHUB Model K1032 (\$1,685) support 10BaseT, 10Base5, and 10BaseFL connections. The unmanaged hubs can be upgraded to support Klever's KVIEW In-Band network management software (\$399). 408-735-7723; fax, 408-735-7724.

Pinacl Communications' MaxiHub Dataguard boasts a variety of security benefits, including constant network monitoring, immediate detection of unauthorized users, alerts, and the ability to disable ports when an authorized user is detected. The hubs (\$1,995 to \$3,549) are available with 8 or 24 ports and 10BaseT UTP or 10BaseFL fiber-optic connections. 914-345-8155; fax, 914-345-2807.

Digital Equipment Corp. introduced packaged stackable solutions that provide users with 10BaseT Ethernet connections for as little as \$83 per port. The Intelligent Stackable Starter Package includes the DEChub 90 and three DECrepeater 90Ts (\$1,995). 508-486-5198.



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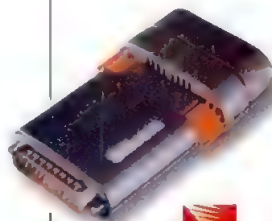
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Media Unit.....\$50

ARCnet

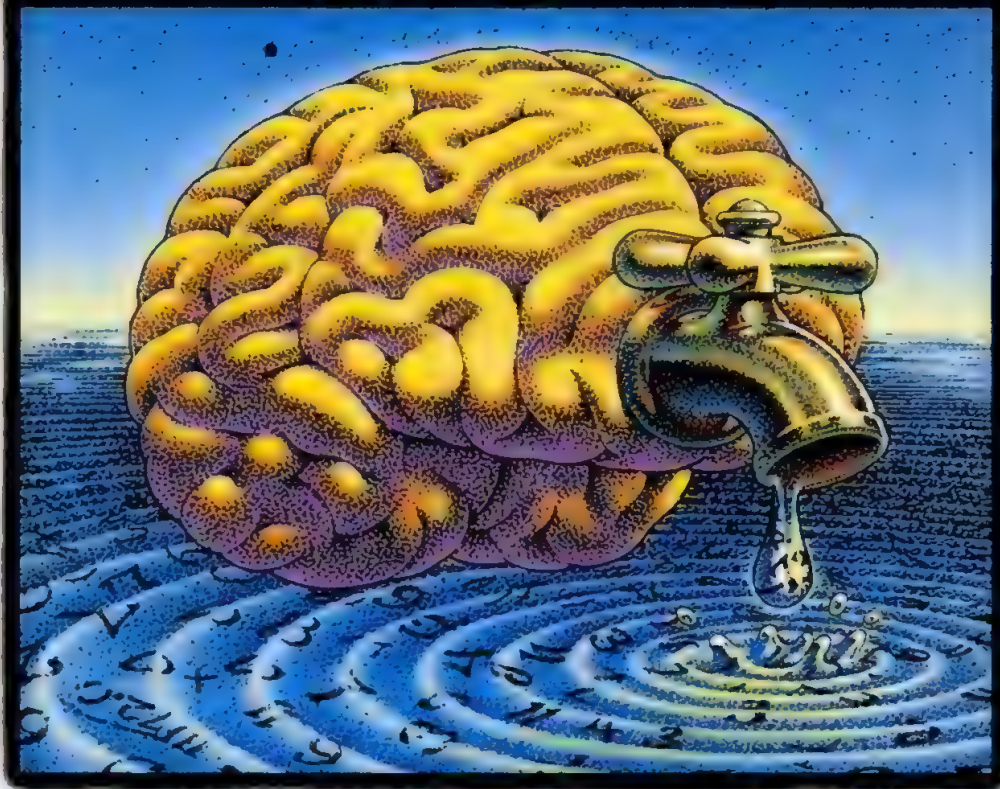
Coax or Twisted-Pair...\$119



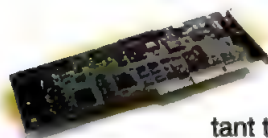
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Better Late than Never

Token-Ring switches promise to deliver affordable performance gains.

By Garry Frenkel

It seemed inevitable. Though Token-Ring offers more bandwidth than Ethernet, some users would need still more. Like Ethernet users, Token-Ring network managers are turning to switches to solve their bandwidth woes. Standard Microsystems Corp. (SMC) has already delivered a Token-Ring switch; IBM and Madge are set to counter early next year.

A Token-Ring switch and an Ethernet switch are nearly identical: Each uses a high-speed device, such as a bridge, to divide a large LAN into several smaller segments. With fewer nodes on each segment, each PC has access to more bandwidth. The segments can still communicate as a single workgroup through the switch.

Quirks in Token-Ring technology, however, complicated the development of switches. The first problem was the speed limitation of Token-Ring chip sets: The existing chip sets simply could not receive the maximum capacity of small Token-Ring frames. Texas Instruments, the manufacturer of most non-IBM Token-Ring chip sets, corrected the problem with its Packet Blaster chip—a coprocessor that speeds up the Token-Ring chip set.

The second problem was a bit more difficult to solve. The bridging method favored by most Token-Ring vendors, called *source routing*, poses some difficult

network design issues. According to the original source routing implementations, a packet can traverse—or hop—up to seven bridges between any two nodes, and each of those bridges can only connect two networks. But switches typically interconnect eight or more networks. To trick source routing into thinking the multiport switch is a two-port bridge, vendors created a virtual backbone inside the switch. This makes each of the switch's ports look like

the adjoining network. Currently, the only available buffered switch is SMC's ES/1 (roughly \$3,000 per port). The ES/1 uses a custom chip to perform source routing. Standard Microsystems created the new source routing implementation to recognize multiport switches and forward packets in a single hop.

Because receiving the entire packet introduces additional delay, IBM and Madge are developing cut-through switches. These determine the destination of an incoming packet and forward it byte by byte. This reduces the switch's *latency* (the time it takes for a packet to travel through a switch) and should therefore lead to higher throughput. But because they have no error checking, cut-through switches will pass bad frames.

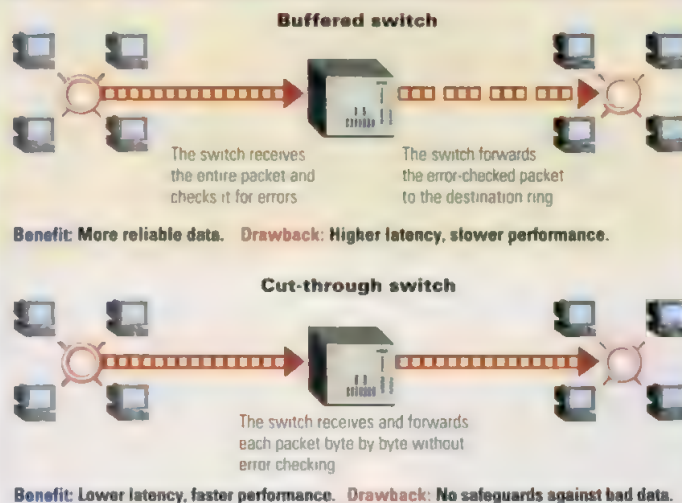
IBM and Madge address the source routing problem in different ways. Madge is using source routing in conjunction with a custom Token-Ring chip to perform the switching. IBM, on the other hand, simply avoids the technology: Its switch will not utilize source routing and will instead use a transparent bridging technology to forward frames.

The new cut-through switches from IBM and Madge should be available by early 1995. Madge estimates a selling price of \$1,500 to \$2,000 per port. IBM is

threatening to shake up the market by pricing its switch at from \$600 to \$700 per port.

Whether you settle on a cut-through or buffered switch will largely depend on the network protocols you run. Novell's IPX, for example, requires a station to acknowledge the receipt of a frame before the sending station can deliver the next frame. A cut-through switch's low latency could improve IPX performance; a buffered switch could slow it down.

A Tale of Two Switches



a two-port bridge. The drawback is that the switch necessitates an extra hop, restricting the design of the network.

The new Token-Ring switches will have to tackle both problems. How they tackle them, though, depends on the switch type. As in Ethernet, there are *buffered* and *cut-through* switches.

A buffered switch is basically a high-speed bridge. It reads and error-checks an entire packet and then forwards it onto

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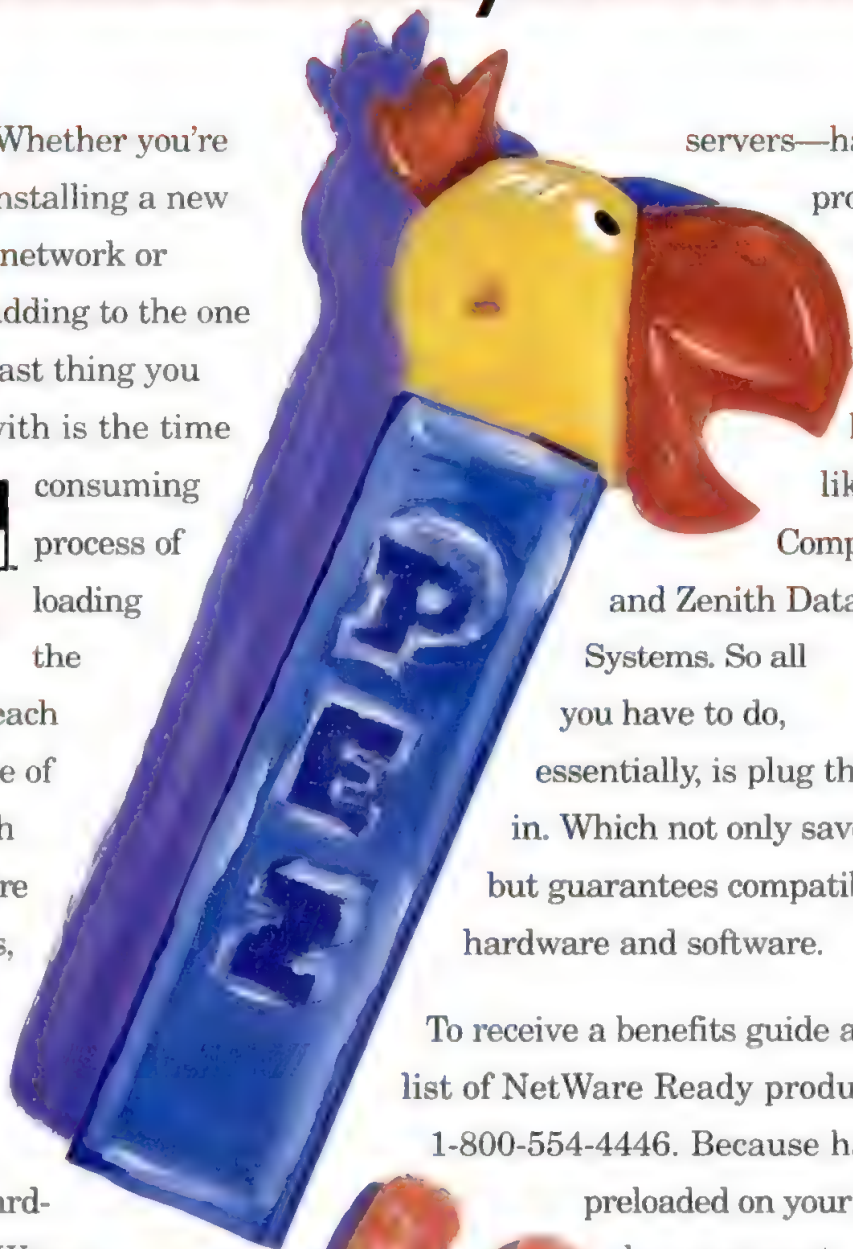


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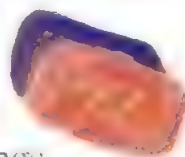
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Virtual Networking: Worth the Headache?

I couldn't believe my ears. There I was, talking to a savvy network planner, and he was telling me that he spends nearly \$80,000 a month just moving people around his network.

\$80,000 a month. Is that ridiculous? Apparently not. For many networks, moving users can account for 10 percent of operational cost. Given a multimillion-dollar budget. . .well, you can do the math.

Internetworking leaders including Cabletron, Cisco, Fore, Newbridge, SynOptics, 3Com, Ungermann-Bass, and a host of others think they have found a way to reduce this cost, though, and it's called *virtual networking*—the grouping of nodes into logical (rather than physical) workgroups. You've heard of VLANs. I wrote about them two issues ago. VLANs let you move nodes to different workgroups simply by moving icons on a management screen.

Could all of these vendors be wrong? Possibly. There's a lot of truth to what you hear about VLANs—and what you hear is that they will solve all your problems. But as a network manager, you had best proceed cautiously. Here's why.

The biggest problem with VLANs is their lack of scalability. They simply become too difficult to maintain when they're spread across more than three hubs. This is because the network manager has to connect the LAN backplanes of different hubs together by hand to obtain the arbitrary grouping of all ports and modules.

Note, though, I said *possibly*. To break through this limitation, most vendors moved from standard Ethernet to high-speed frame switching. Most added a proprietary header to the media-access control (MAC) frame indicating VLAN membership. The major drawback here is a lack of interoperability with other vendors' VLAN-enabled hubs. The industry needs a standard way—another layer, if you will—to construct VLANs. This additional layer must provide a standard VLAN address for each frame.

Vendors are turning to routing as the way to connect these hubs together in a VLAN. This is why a good number of hub vendors, like Cabletron, integrated routing into their hubs. That's fine for installations without routers, but the approach that I like for existing installations is that taken by other



By Nick
Lippis

vendors, like SynOptics. By buying Coral Networks, SynOptics will offer another option: Either use your own routers or use one of their hubs that includes routing software.

The approach, though, that I *really* like is Newbridge Networks' VIVID (Video Voice Image Data) architecture. Newbridge uses frame and cell switching to increase LAN performance while distributing routing among hubs and a SPARC station to both ease network-management pain and provide VLAN support. If it delivers increased performance without management

difficulties, VIVID just might become the approach of choice.

So scalability is a crucial challenge for VLANs. There are a few other reasons to hold off for a while before jumping into virtual networking. First, no one really knows how difficult it will be to manage VLANs and to track this new logical layer of network. The bottom line is—no one has a clue.

The other difficulty with VLANs and switched LAN technology in general is that they will force a new physical/frame network management model into the industry. Since only switches will see all frames on a given virtual workgroup, standalone protocol analyzers like the Network General Sniffer, for example, may become obsolete. New management engines will have to be placed in hubs that collect frame-level management data and report it back to centralized management systems. Little wonder that Network General just inked an agreement to integrate its software with SynOptics' software.

You can make life simpler for yourself by first implementing VLANs on backbones. You'll be able to group hubs together in workgroups. This will give you a feel for VLANs without forcing you into the complexity of having to track VLANs spread across hundreds or thousands of hub ports. It's only after network managers start using VLANs in production mode that the industry will know whether the technology will pay you back for the time spent configuring the workgroups.



VLANs are supposed to help solve management problems. Instead, they might just create problems.

NICK LIPPIS is a contributing editor of *PC Magazine* and is president of Strategic Networks Consulting (Rockland, Massachusetts), a consultancy specializing in enterprise networking. He is also publisher of *The Internetwork Advisor*, a monthly newsletter, and can be reached via MCI Mail at Lippis or via the Internet at 405-5710@mciemail.com.



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The New Internet?

David, let me use some ancient history to position the business use of the Internet against that of AT&T's recently announced NetWare Connect Services, a national public network—run and maintained by Novell—based on NetWare over IPX or IP.

In 1972, I did a survey for a radio magazine and found that one out of every ten private vehicles on the interstate highways had a citizen band (CB) radio on-board. Back then, plain vanilla—traveling moms and pops adopted CB radio handles that reflected their wildest dreams as they did mundane things like help each other with road directions, exchange information on restaurants and clean rest rooms, and announce the location of speed traps. But soon, the polite society of travelers broke down. As the number of users grew, the free, shared radio network was monopolized by broadcasts of nefarious solicitations, profanity, and other nastiness. The bad drove out the good.

Twelve years later, my informal survey of Interstate 10 in Florida found CB antennas are now rare, but 12 percent of private cars carry visible cellular phone antennas. This limited-access and often costly service isn't as much fun or even as useful for travelers as CB radio, but it's free of unsolicited nastiness.

The relationship of the Internet to NetWare Connect Services is analogous to that of CB radio to cellular phones: The bad will drive out the good on the Internet. Advertisements broadcast across newsgroups, e-mail forgery, political diatribes, and general anarchy will drive average citizens to more costly but more private electronic enclaves.

AT&T's NetWare Connect and similar services emerging from other telephone and software companies are the cellular radio of the age: coolly practical and pricey. They will serve businesses nicely, but they aren't fun.

If you want to *outsource* (farm out to an integrator or VAR) your network management to the same folks who persist in thinking that ISDN is only about voice, then NetWare Connect is just your style. But if you have any faith in your own WAN-building abilities, there are options—such as rolling your own system with switched digital lines—that will be less costly, just as reliable, and more invigorating than using a server run by the phone company.



Frank Derfler:
*If you want to farm
out network
management, then
NetWare Connect is
perfect for you.*

How zebras change their stripes! Six issues ago, Frank, you weren't very hot on the idea of a NetWare network running over IPX. But as I noted then, Novell's seemingly disconnected suite of products—from TCP/IP stacks to directory services—offered the pieces of a functional national NetWare network.

AT&T's NetWare Connect offers much more than simply streamlining a company's internal workings through network management. With NetWare Connect, AT&T and Novell hope to facilitate intercompany connections. Internetwork reengineering is more than simply outsourcing network management. It's facilitating more efficient relationships. With NetWare Connect, car dealerships, for example, will be able to tie their networks into the networks of automobile manufacturers to

order and deliver customized cars in days, not weeks.

There are sure to be customer-oriented applications as well. One such application might allow you to pick from a menu of flowers displayed on-screen, design your own bouquet, and send it to a friend.

Certainly, questions and challenges abound. Pragmatic questions—such as how billing for such customer-oriented applications might work—still need to be answered. As companies begin to connect to other companies' networks, more

technical challenges must be answered. How, for example, will these companies merge their existing NetWare 4.0 directory service structures?

Architecture is an issue as well. Currently AT&T and Novell are talking about using Novell's Network Link Service Protocol (NLSP) to link routers together. Today, however, NLSP is only widely supported by Novell's Multiprotocol Router. 3Com is the only leading router vendor to back NLSP. If a national NetWare network is to be successful on these fronts, then the router vendors must add NLSP support.

If Novell and AT&T can resolve these and other issues, they may be onto something really big. Some companies will still build their own WANs, no doubt. But many others will find that by offloading the cost of the expertise needed to support a WAN to Novell, they'll be able to realize a sizable cost savings. And all will find new ways to offer their services to companies and users alike.



David Greenfield:
*NetWare Connect
is far more than
just getting rid
of network
management.*

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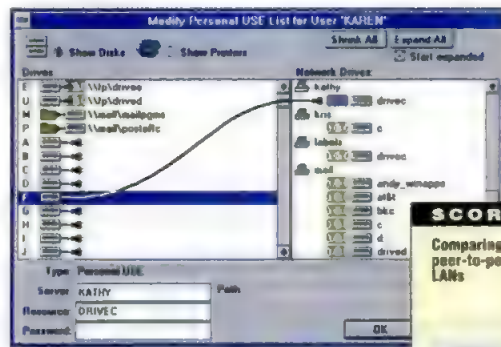
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User-to-User

BY NEIL J. RUBENKING

Time to Foil Those Laptop-nappers!

As laptop and notebook computers increase in value and popularity, so does the problem of theft. Here's a simple procedure that will probably annoy the thief, maybe make your laptop worth just a bit less on the black market, and possibly get it returned to you (especially if it was actually lost instead of stolen). The procedure makes your computer appear to have a custom identification number burned into ROM. This number always comes up when the computer is turned on. Just how that message is produced will not be obvious to the casual user, and it might prove to be just pesky enough to make a thief, finder, or buyer believe that it is really in ROM.

Here's how to install the routine:

1. Put the file LAPNAP.BAT (Figure 1) in the root directory of your boot-up drive. This is a batch file that uses @ECHO commands to display a message

suggesting a ROM-based security system.

If your editor doesn't have a direct method of drawing lines, you can usually produce the line characters with the following procedure: Hold down the Alt key, type the ASCII code of the desired character on the numeric keypad, and then release the Alt key. As a last resort, EDLIN does support this method. The ASCII codes for the characters used in LAPNAP.BAT are: `␣` 201, `—` 205, `¶` 187, `||` 186, `␣` 200, `␣` 188.

Test to see what the message looks like by typing LAPNAP at the DOS prompt.

2. Rename the file using the command `REN LAPNAP.BAT PROMPT#.BAT`, where # represents the invisible character you get by holding down the Alt key, typing 255 on the numeric keypad, and then releasing the Alt key. When you do this, it will look like you typed a space between PROMPT and .BAT. The DIR listing for this file shows PROMPT BAT with nothing to indicate that there is a character after the T in PROMPT.

3. Hide the file with the command `ATTRIB+H PROMPT#.BAT`. Again, the # is ASCII character 255. This time if you do a DIR, the file won't show, but if you type PROMPT# at the DOS prompt, your message will appear.

4. Modify your AUTOEXEC.BAT file so that the last command is PROMPT# followed by your prompt string. Be sure to put a real space between the ASCII character 255 and your prompt string. To make the apparent extra space after the PROMPT command less obvious, add extra spaces after every command in your AUTOEXEC.BAT file—for example,

```
@ECHO OFF
SET COMSPEC=C:\COMMAND.COM
PROMPT $P$G
```

5. Restart your computer. Your security message will appear on the screen and will really seem to come from ROM. For the best effect, your AUTOEXEC.BAT file should start with @ECHO OFF so that nothing displays on the screen before the warning message.

Finally, if your computer is lost or stolen and someone calls you because of the LAPNAP.BAT message, don't forget the promised reward!

*George H. Trudeau
Sandwich, Massachusetts*

► **PC MAGAZINE:** If you make sure your laptop or notebook loads ANSI.SYS from CONFIG.SYS, you can add some teeth to the warning displayed by LAPNAP.BAT.

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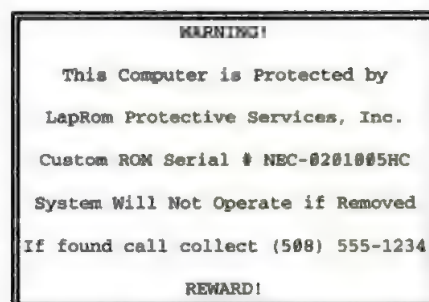


Figure 1: LAPNAP.BAT gives the impression that your laptop is protected by a ROM-based security system.

TURKEY



378 PC MAGAZINE AUGUST 1994

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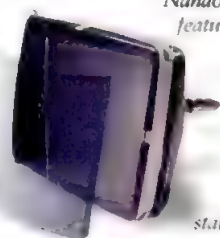


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F-1200M	12"	0.28mm	60-85kHz	1280x1024
F-1000A	10"	0.28mm	60-85kHz	1024x768
F-1200A	12"	0.28mm	60-85kHz	1280x1024
F-1000M	10"	0.28mm	60-85kHz	1024x768
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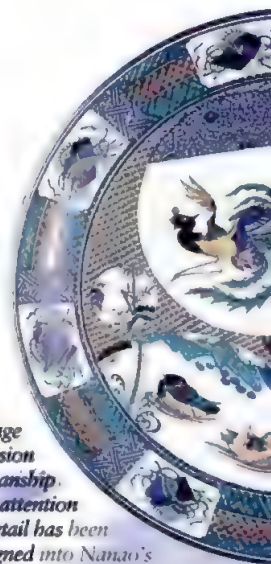


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Tutor

BY JEFF PROSISE

How Your System STACKS Up

If you were to cast your vote for the most obscure CONFIG.SYS command, what would it be? FCBS? DRIVPARM? What about STACKS? A recent conversation on PC MagNet convinced me that STACKS is easily one of DOS's most misunderstood commands. Some users steer clear of it and end up losing almost 2K of conventional memory by accepting DOS's default STACKS setting. Others set it to a value that is much higher than necessary and waste even more conventional memory. Memory may be cheap, but conventional memory—the addresses from 0K to 640K that DOS programs run in—is a precious resource. This means that all users could benefit from understanding the STACKS command in order to determine the optimal setting for their PCs.

Our challenge, then, is to lay bare the STACKS command and learn what it is, what it does, and how it affects a PC's operation. We'll tackle this undertaking in three steps. First, we'll review the concepts of stacks and hardware interrupts and see how they interrelate. Second, we'll examine what DOS does when a hardware interrupt occurs and how its handling of the interrupt is affected by the STACKS setting. Finally, we'll use what we learned (together with a handy little utility that you can download from PC MagNet) to figure out your best STACKS setting.

WHAT IS A STACK? A *stack* is an area of memory where software places data for temporary storage. Data is moved in and out of the stack in a particular way. The usual analogy is a stack of plates in a cafeteria serving line. The last plate you put on the stack will be the first one you

can take back off. If you put three plates on the stack, the order in which you take them off is the reverse of the order in which you put them on. If plate A went on first, followed by plate B and then plate C, you'll take plate C off first, then plate B, and then plate A. Computer scientists have a term for this system. It's called *last in, first out* (LIFO), because the last plate you place on top is the first one you'll pull off.

Rather than storing plates, a computer's stack stores data. When a computer adds a data item to the stack, we say that it *pushes* the data onto the stack. When the computer retrieves the data, we say it *pops* the data from the stack. Intel microprocessors provide a pair of handy instructions for getting word-size (16-bit) chunks of data on and off the stack: PUSH and POP. Programs frequently use PUSH and POP instructions to save data that they don't need now but will need later. Rather than copying the values off to some variable, pushing them onto the stack and popping them off later when they're needed is much easier.

The stack is used for other things besides routine data storage. When a program calls a subroutine, the return address (the point at which execution resumes when the program ends) is saved on the stack. High-level languages such as C and Pascal also use the stack for passing parameters to functions and

subroutines and to store local variables. For a large program containing functions that call other functions comprising an assortment of local variables, stack space requirements can mount up very quickly.

Intel CPUs reserve a special pair of registers called SS and SP to specify the stack's location in memory. SS (for *stack segment*) holds the segment address, and SP (for *stack pointer*) holds the offset address. The stack pointer starts out pointing to the highest memory address in the stack; from there, the stack grows downward in memory. When a program pushes a 2-byte value onto the stack, SP is decremented by 2, and the value is copied to the address stored in SS:SP. Popping a value off the stack retrieves the last value that was pushed and increments SP by 2. The more data the stack contains, the farther down in memory it reaches.

Where is the stack located? It varies—not just from PC to PC, but from moment to moment. When you start a program, DOS sets the SS and SP registers to appropriate values for that program. For a .COM file, DOS puts the stack at the highest address in the 64K segment in which the program is loaded. From there, it grows downward toward the program's code and data. If the code and data occupy 48K, then the stack has 16K in which to grow. If the stack outgrows its allotted space, the program will probably crash, because code or data will be overwritten. This is called a *stack overrun*. For an .EXE file, DOS sets SS to a separate stack segment that holds nothing but stack data and SP to a value stored in the .EXE header. When a programmer links an .EXE-formatted program, he specifies how much stack space it will require, and the linker sets the .EXE header accordingly.

THE TROUBLE WITH INTERRUPTS Programs must avoid stack overruns at all costs, because a stack that grows beyond its preset amount of memory may over-

All users could benefit from understanding the STACKS command in order to determine the optimal setting for their PCs.

write code or data elsewhere in memory. If a program is careful to reserve an adequate amount of stack space for itself, it should be able to avoid stack overruns, right? Not necessarily. There's another problem that we haven't considered.

Several times a second, your PC's CPU is interrupted by signals from peripheral chips and devices saying that they need attention. These signals, called *hardware interrupts*, come in through IRQ (interrupt request) lines—you know, those pesky settings you have to choose when you install a new sound board or COM port. After passing through one or more interrupt controller chips, which sort and prioritize incoming hardware interrupts, the signals eventually make their way to the CPU. A CPU's interrupt-processing center is a beehive of activity, with hardware interrupts typically arriving at the rate of 20 or more per second. Sources of hardware interrupts include, among others,

- the system timer, which generates more than 18 interrupts per second at regularly spaced intervals,
- the keyboard, which generates a hardware interrupt whenever a key is pressed or released,
- the COM ports, which generate a hardware interrupt whenever data arrives,
- the mouse, which generates hardware interrupts when it is moved and when its buttons are clicked, and
- hard disk controllers, which generate a hardware interrupt to signal the completion of read operations—often after each sector is read.

When a hardware interrupt occurs, the program that is currently running gets suspended and a special interrupt handler somewhere in memory (maybe in the ROM BIOS or perhaps in RAM as part of a mouse or serial-port driver) gets executed. The interrupt handler must do its work as quickly as possible so that the interrupted program can resume. Most hardware interrupts are serviced very quickly, requiring no more than a few microseconds.

The trouble with hardware interrupts is twofold: First, they can occur at just about any time. Second, most hardware interrupt handlers do not have stacks of their own. They assume that the program that was interrupted has enough stack space to piggyback them, and they there-

fore use whatever stack is current. This saves execution time and simplifies coding, because this way the SS and SP registers do not have to be modified.

Usually, piggybacking isn't a problem. The problem occurs when several hardware interrupts occur in rapid succession. If another interrupt occurs before the last interrupt handler has finished processing, and then another, and then another, and so on, the interrupt handlers—each with its own stack space requirements—get nested several levels deep. If the interrupted program contains just enough stack space for itself, then the nested interrupt handlers may overrun the stack.

Hardware Interrupts

Interrupt number	Associated device
02h	Nonmaskable interrupt (NMI)
08h	System timer
09h	Keyboard
0Ah	Various devices (often unused)
0Bh	Serial ports COM2/COM4
0Ch	Serial ports COM1/COM3
0Dh	XT hard disk controller
0Eh	Floppy disk drive controller
70h	CMOS real-time clock
72h	Various devices (usually unused)
73h	Various devices (usually unused)
74h	PS/2-style mouse
75h	Math coprocessor

Figure 1: DOS's STACKS code intercepts these hardware interrupts.

The program will in all likelihood crash, and the operating system may go down with it.

DOS TO THE RESCUE The designers of DOS 3.2 realized that stack overruns due to nested hardware interrupts were the root cause of many mysterious system crashes, so they built in a safeguard that still exists in DOS. At start-up, DOS sets aside a small amount of memory to serve as stack space for hardware interrupt handlers. This space is called the *stack pool*. DOS intercepts the hardware interrupts listed in Figure 1 and changes the SS and SP registers to point to empty stacks in the stack pool so that hardware interrupt handlers don't have to share stack space with the running application. The STACKS command controls the number of stacks in the stack pool and the size of each. The command STACKS=9, 128 sets up nine

stacks of 128 bytes each. This is the setting that DOS defaults to on most PCs if CONFIG.SYS lacks a STACKS statement.

As long as DOS has enough internal stack space to handle all the hardware interrupts that it receives, everything goes smoothly. If it runs out of stack space, however, the dreaded "Internal stack overflow; system halted" message appears, and DOS locks up the system. If EMM386.EXE is loaded, you'll get the message, "EMM386 has detected error #12 in an application," followed by the memory address of the error and some advice about what to do.

A disassembly of the STACKS code in IO.SYS reveals that there is only one occasion when this will happen: when the number of nested hardware interrupts exceeds the number of stacks in the stack pool. For example, if DOS was started with STACKS=9, 128 and ten hardware interrupts occur so quickly in succession that none finishes processing before the tenth one occurs, DOS gives up the ghost. This is easily fixed by rebooting with more stacks—say, with STACKS=16, 128.

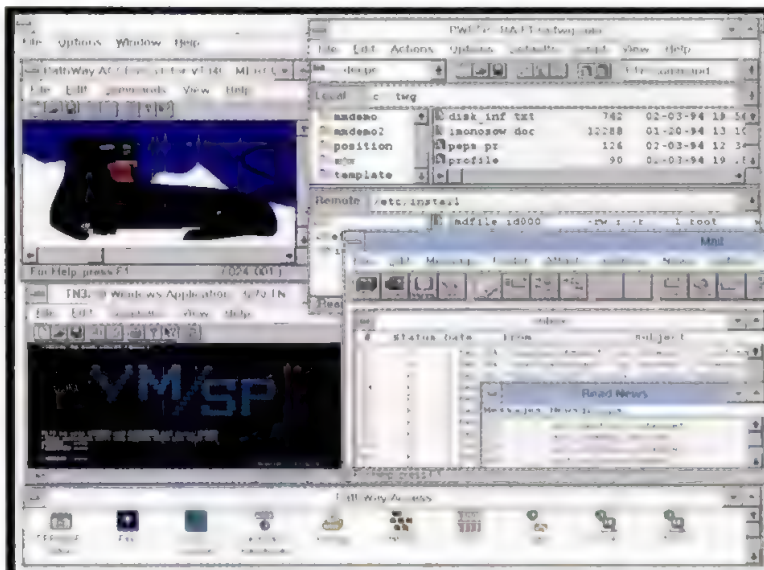
Contrary to what you may have heard, DOS does not report a stack overflow if one of the stacks in the stack pool grows large enough to overwrite part of the stack below it. What DOS does do is this: During start-up, IO.SYS copies a unique "magic number" to the top 16-bit word value in every stack; the magic number is actually a pointer to an 8-byte data structure that holds important information for that stack (including a 1-byte status value and space to store the values in SS and SP so that they can be restored after a stack switch). Before switching to a free stack, DOS checks the word at the top of that stack. If that word no longer contains the magic number, DOS knows that the next higher stack in memory has overflowed into this one. What DOS does next is interesting. To avoid overwriting data in the higher stack (and causing a nasty crash when the interrupt using it returns), DOS places a 3 in the status byte for the current stack to flag an overflow in the stack above it. Then it searches the stack pool for another free stack and apparently never again uses the stack

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What this means is that DOS adapts its stack pool on the fly so that an interrupt handler can use more than the amount of stack space allocated to it without crashing the system. But when such an overflow occurs, DOS reduces the number of stacks in the stack pool. If you start with `STACKS=9,128` and one stack overflows into the stack below it, you end up with the equivalent of `STACKS=7,128` plus `STACKS=1,256`. In other words, you now have eight stacks; seven are 128 bytes in length, and one is 256 bytes in length. Stack overruns in the stack pool don't directly cause shutdowns but can lead to a shutdown if they cause the stack pool to become exhausted.

When the stack pool runs out, DOS's reaction is simple. First it performs some housekeeping, which includes disabling further interrupts so that the CPU will no longer respond to them. It also checks a bit flag in low memory that is set when Windows is running and calls a subroutine in `IO.SYS` if the bit is set to 1. That subroutine, in turn, invokes an undocumented function in Windows' `DOSMGR` virtual device driver that brings the DOS session to the foreground, switching it to full screen if it's running in a window. Then DOS displays the stack overflow message and enters an endless loop with the equivalent of the following program statement in BASIC:

```
100 GOTO 100
```

The system is locked solid. Even Ctrl-Alt-Del won't do anything, because interrupts are disabled.

OPTIMIZING THE STACKS SETTING

The problem with DOS's internal stack pool is that it eats up memory. A setting of `STACKS=9,128` requires almost 2K of conventional memory that could otherwise be served up to your application programs. The optimal `STACKS` setting is one that provides an adequate amount of protection from stack overruns without needlessly tying up memory. Unfortunately, this setting varies from PC to PC, because it is highly hardware dependent.

Most PCs run fine with a setting of `STACKS=0,0`, which uses no memory and effectively disables DOS's monitoring of

hardware interrupts. But some require higher `STACKS` settings—much higher. On PC MagNet, I learned of one PC that wouldn't run with a `STACKS` setting lower than `STACKS=61,128`. Why? Its hard disk contained 61 sectors per track. When an entire track was read at once, the hard disk controller generated 61 interrupts rapidly in succession. For some reason, the PC couldn't finish processing one interrupt before the next one arrived, resulting in 61 nested hardware interrupts. Why this happened is unclear. It could be because a memory manager was loaded. Memory managers tend to slow down interrupt processing. Allowing DOS to get in on the act slows down processing, too, because every time an interrupt occurs, DOS has to search its stack pool for an unused stack. This sometimes adds a relatively large amount of overhead to the interrupt-processing code, because the hard-disk interrupt handler in the BIOS typically does little more than set a flag.

So how do you determine the optimal `STACKS` setting? There are several ways. One is to try different `STACKS` settings (starting with `STACKS=0,0`) and increase them until you no longer experience system crashes. Another is to inspect DOS's stack pool manually to see which stacks have been used and which haven't. If 12 have been used, then you need at least 12 stacks. This route requires a lot of poking around in memory with `DEBUG`, however, and the method you use to find the stack pool varies with different DOS versions. Most users would find this quite confusing.

To make life easier, I wrote a small program called `STACKMON`, which you can download (as `STACKM.ZIP`) from Library 3 (Tutor) of PC MagNet's Utilities/Tips Forum. (Sorry, `STACKMON` is a little too long to print as a `DEBUG` script.) `STACKMON` is a TSR that monitors hardware interrupts and stack usage. It counts nested hardware interrupts and reports the number back to you. To install the program, type `STACKMON` at the command prompt. Each time you run it thereafter, it reports a value called `MaxInt` that reflects the maximum number of hardware interrupts that were processed concurrently. If `MaxInt` is 12, then you should

use a `STACKS` setting of at least `STACKS=12,xxx`. On most PCs, `MaxInt` will never go above 2 or 3. And most PCs will run fine with `STACKS=0,0`, because programs typically contain enough extra stack space to piggyback two or three interrupt handlers. Higher numbers indicate you need a helping hand from DOS.

`STACKMON` doesn't help you determine the size of each stack, but 128 bytes is a good starting point. If `STACKMON` reports `MaxInt=12`, and you still get stack overflows with, say, `STACKS=16,128`, increase the size setting to 256. It's rare that an interrupt handler needs more than 128 bytes of stack space, but apparently such handlers do exist.

Here are two suggestions for running `STACKMON`: First, since DOS adds to a PC's interrupt-processing overhead, run `STACKMON` with `STACKS=0,0` and with a very high `STACKS` setting—say, `STACKS=64,128`. Theoretically, `MaxInt` values for the two could differ. Second, to get an accurate report from `STACKMON`, you'll need to install it and leave it installed for the course of a normal workday. Nested hardware interrupts may occur only every so often, so installing `STACKMON`, getting a `MaxInt` report, and immediately uninstalling it won't tell you much of anything. If you use `STACKMON` with Windows, install it before starting Windows. You can then get `MaxInt` reports by running `STACKMON` in a DOS box.

Now, the caveat. I think `STACKMON` works, but I can't be absolutely sure. All three PCs in my office run great with `STACKS=0,0`, so none represents a good test bed. If you have a PC that won't run with `STACKS=0,0`, I'd love to hear from you. Specifically, I'd like to find out what `MaxInt` value `STACKMON` reports for your PC and whether a number of stacks equal to or slightly larger than `MaxInt` eliminates crashes.

The best way to reach me is MCI Mail (312-3074) or CompuServe (72241,44). Paper mail sent to *PC Magazine* (One Park Ave., New York, NY 10016) works too, but it takes a while to reach me since I live and work far from New York. If you're a `STACKS` sufferer, I look forward to hearing from you! □

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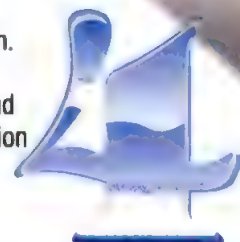
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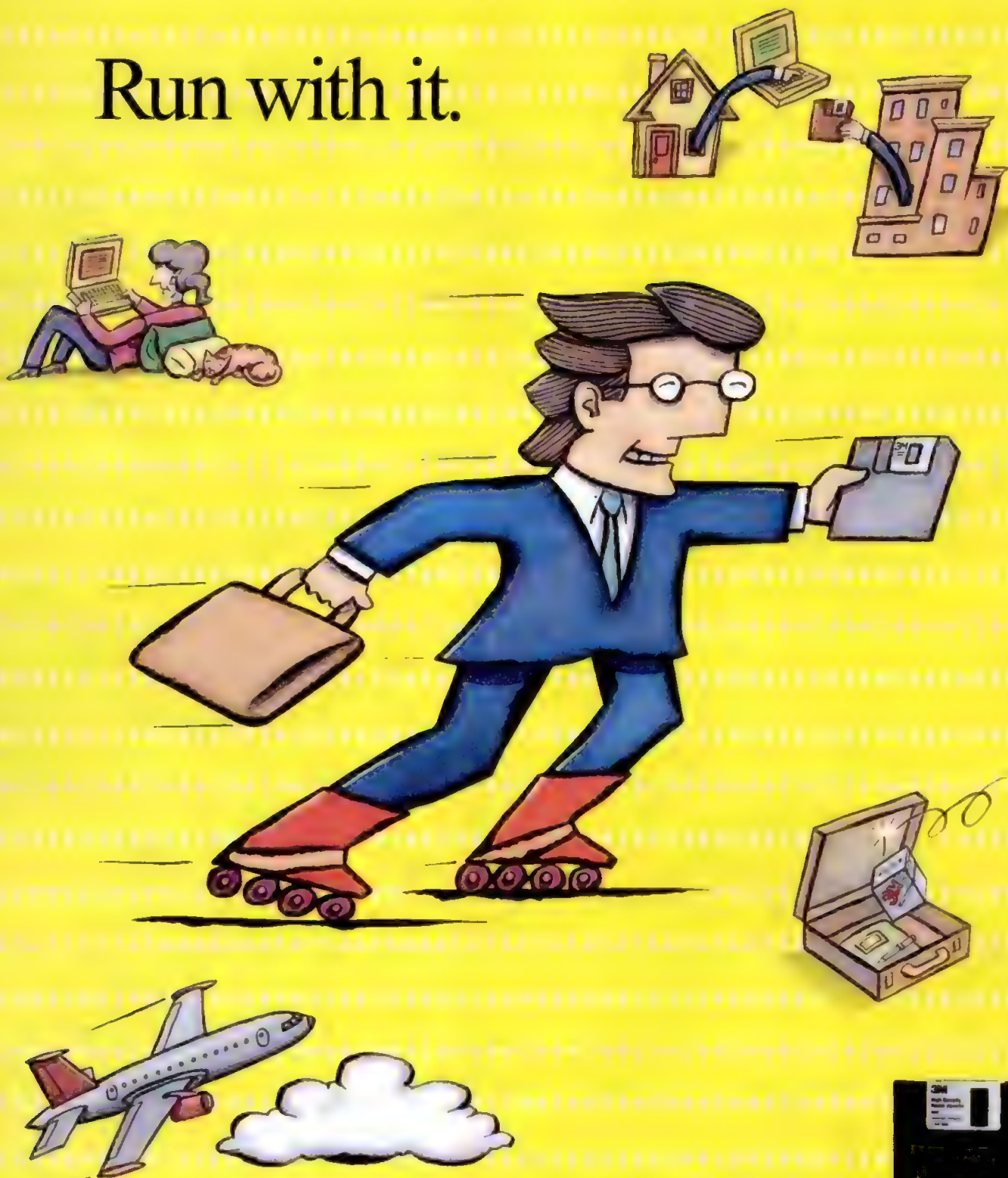
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BY SAL RICCIARDI

A Guide to Data Integrity Rules

The content of a database often forms the basis on which critical business decisions are made. To ensure that the database remains correct and complete at all times, you must establish and enforce the appropriate data integrity rules. As I discussed in the last installment of Corporate Developer (June 28, 1994), if you're fortunate enough to be using a database management system that supports declarative integrity, you need only declare the rules to the database, and it will then automatically enforce them globally. Otherwise, you must write your own procedures to enforce the integrity rules.

In this column, I'll review the different kinds of data integrity rules. The relational model defines five types of integrity: *entity*, *referential*, *column*, *domain*, and *user-defined*. I'll also discuss here a sixth type, *primary-key integrity*. Ideally, your database management system should support and enforce each of these types.

THE ENTITY INTEGRITY RULE Recall that a primary key is the column (or combination of columns) you choose to provide a unique identification for each row in a table. For example, you might use a customer ID to distinguish customers or a part number to identify parts. Under this approach, it makes sense to require that *all* customers have a customer ID or that *all* parts have a part number. Without such a fingerprint, the database loses its primary means of identifying a row.

The *entity integrity rule* simply codifies this common-sense principle: A row must always have a primary-key value. You cannot add a new row that lacks a primary-key value, and you cannot change an existing row if that would result in the loss of its primary-key value. If you attempt to add a new customer without including a customer ID, you violate the entity integrity rule and the database must reject the row. When you define a column as the primary key, you are actually implying that the database should enforce entity integrity. Databases that support primary keys (Microsoft Access and Paradox for Windows, for example) automatically enforce entity integrity; it is assumed by the very action of calling something a primary key.

A number of products require that you add a *nonnull* constraint to the column definition of the primary key to activate entity integrity support. The *nonnull* constraint simply means, "Don't permit any row to omit a value in this column." Still other products (some Xbase packages, for example) provide no support for primary keys or entity integrity. Such products require you to write the code that enforces the entity integrity rule.

THE PRIMARY-KEY INTEGRITY RULE *Primary-key integrity* demands that the value of the key be unique. After all, you can't identify a row uniquely if its primary-key value is not distinct from all others. Since it is really part of the definition of a primary key, products that support a primary-key type enforce this rule automatically. For example, Microsoft Access and Paradox for Windows auto-

matically prevent you from duplicating a primary-key value.

Other database products require you to add a *unique* constraint to the primary-key column definition to ensure enforcement of the rule. Database management systems that follow ANSI SQL-89, for example, require you to add both the unique constraint for primary-key integrity and the *nonnull* constraint for entity integrity. If your product supports ANSI SQL-92, on the other hand, you need only to declare the column as a primary key; support for entity and primary-key integrity is then assumed. Again, some products (some Xbase packages) still provide no support for primary keys, so you must write code to enforce the primary-key integrity rule.

THE REFERENTIAL INTEGRITY RULE

When you design a database, you divide your information into many subject-based tables to minimize data redundancy. You then provide your database management system with the means to connect the data back together again by placing common columns into related tables. To represent a one-to-many relationship, for example,

Ideally, your database management system should support and enforce each of the five different types of data integrity rules.

take the primary key from the one table and add it to the many table as an additional column. To reconnect the data, the system then takes the value in the many table and looks up the corresponding value in the one table. In this way, the values in the many table always reference the corresponding values in the one table.

(For a more complete discussion of table relationships, see "Database Design: Redundancy and Normalization" in the Corporate Developer of January 25, 1994.)

You can imagine ways in which the primary-key column in the one table could become out of sync with its references. Suppose, for example, that your database has a one-to-many relationship between customers and orders and that you want to delete a customer. If that customer has order records in the Orders table, those records will become *orphans* when you delete the customer record. They will have a customer ID that is no longer valid,

since the row it references no longer exists. The database will have lost its *referential integrity*.

Keeping such references locked in sync is what referential integrity is all

would no longer have any related order records. Such an operation is not only cumbersome, but it also leaves the database in a temporarily inconsistent state. That is, for a short time there are two cus-

tomer records for the same customer.

What you really need is for the system to update all the required tables automatically as part of a single operation to keep them in sync with your changes. In other words, the database management system should support a *cascade* option.

THE CASCADE OPTION When a database management system supports the cascade option, it usually im-

able. For example, when you delete the target of a reference, you might want to set the references to a specific default value (a default supplier, for instance). Or you might want to blank out (set to null) the references to indicate that something is missing. Databases that comply with ANSI SQL-92 will support both of these options together with cascade update and cascade delete.

SUPPORT VARIES Support for referential integrity and referential actions varies greatly among database products. As of this writing, Microsoft Access enforces referential integrity and offers both the cascade-delete and the cascade-update options (see Figure 2). Paradox for Windows, on the other hand, supports referential integrity and cascade update but does not support cascade delete. Products such as dBASE and Microsoft FoxPro, which offer only procedural integrity, require that you write code to implement referential integrity. SQL Server, Version 4.21, supports referential integrity but requires that you use *triggers* to implement the cascade update and cascade delete options. The server invokes the user-written trigger procedure automatically in response to certain actions, such as an attempt to update or delete. The obvious disadvantage of using triggers to implement referential actions is that you must know how to write the procedure. That is, you have to know how to accomplish cascade update and cascade delete using the features available in your particular prod-

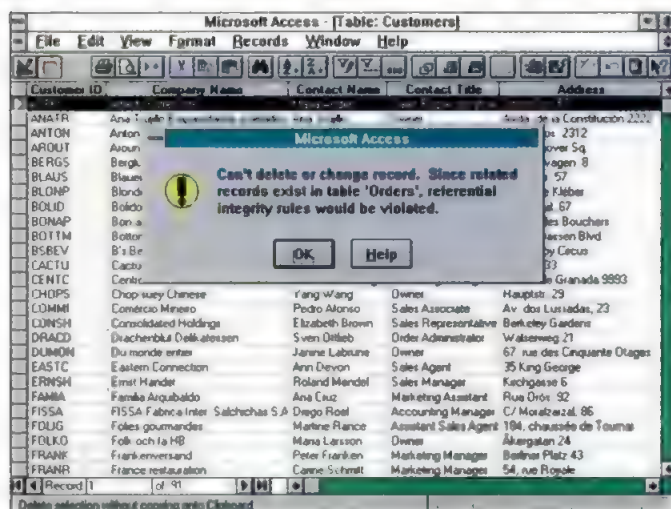


Figure 1: When you enforce referential integrity with Microsoft Access, you cannot delete a row or change a primary-key value if there are any related records in related tables.

about. The referential integrity rule says that what you reference must exist and that your database management system should make sure this condition always remains true. How, then, should the rule be enforced?

The most obvious solution is to reject any operation that would violate referential integrity. Under this approach, the database would reject both updates that change the target of a reference and deletions that remove the target of a reference. Microsoft Access uses this technique by default (once you choose to enforce referential integrity), as shown in Figure 1.

In this case, the database restricts all updates and deletions to those that would not violate the rule. In practice, however, a few additional alternatives make sense. You might have a perfectly valid need to change the customer ID for a customer who has orders in the Orders table, for example. By default, the database management system should reject such a change as a referential integrity violation. In such a case, to implement the change, you would have to copy the customer row to a new row with the new ID, change all the related order records to the new ID, and then delete the old customer row, which

plements two independent options: one for updates and one for deletes. When you select either option, the system automatically cascades your changes to all of your tables, thus keeping them synchronized. For example, when you choose the cascade-update option and then update a primary key, the system will propagate that change to all the columns that reference the primary key. Similarly, when you choose cascade delete and then delete a customer record, the system deletes all related order records.

REFERENTIAL ACTIONS Cascade update and cascade delete fall under the general heading of *referential actions*—that is, things that can happen in response to an attempted violation of referential integrity. Depending on your choice of database management product, other alternatives may be avail-

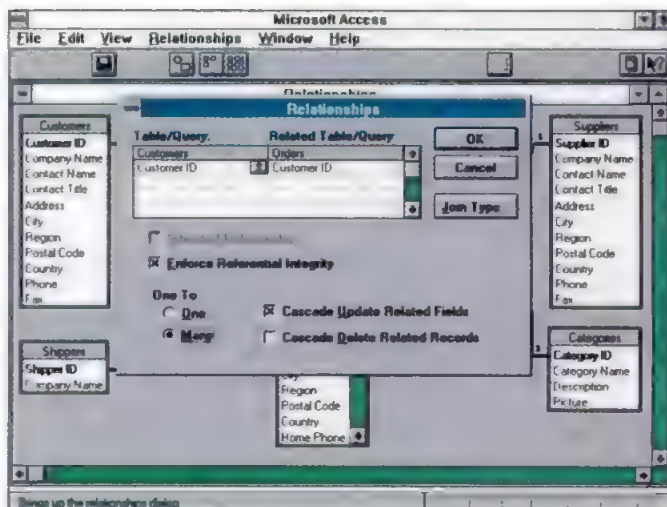


Figure 2: Microsoft Access enforces referential integrity when you choose Enforce Referential Integrity in the Relationships dialog box. You can override this default with the cascade-update and cascade-delete options.

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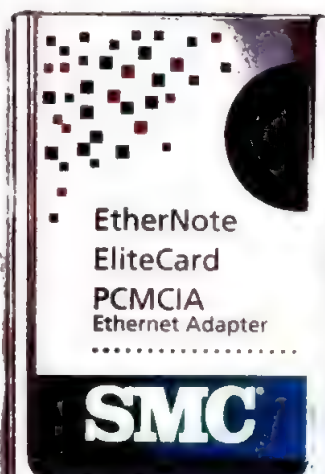
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uct. (A future version of SQL Server will likely include simple declarative support for cascade update and delete.)

Triggers do have advantages, however. They give you flexibility when creating custom integrity rules that go beyond those that can be specified declaratively.

And since they are stored with the database and executed automatically by the system, triggers do not share the traditional procedural disadvantage of being easily bypassed and of having to be copied all over the place.

The integrity rules I've discussed so far concern the structural framework of a relational database—that is, the primary keys and the columns that reference them.

Beyond these rules are the business rules unique to your database.

COLUMN INTEGRITY RULES *Column integrity rules* are used to maintain the values in a particular column. For example, you might want to limit the values in a column either to a certain set of permissible values or to a preset range of values. Most products provide at least some support for column integrity, usually by allowing you to define the rules as part of the column definition. Here, too, there is plenty of variation in the way different vendors implement the feature.

As shown in Figure 3, Paradox for Windows supports column-based validity checks that let you test whether the value in a column is within a certain range. You can also assign a default value if none is supplied or you can avoid the use of a default value altogether by marking a column as *required*, meaning that a value must always be supplied.

Microsoft Access supports the default and required options and also lets you define a custom validation-rule expression that will limit acceptable values to those that meet a certain requirement. You can use this validation rule, for example, to re-

quire that a value come from a specified list (for instance, red, white, or blue).

Products that comply with ANSI SQL-92 support a very flexible feature known as a *check constraint*, which lets you create a wide range of rules for automatically enforcing column integrity.

The screenshot shows the Paradox for Windows interface. The main window displays a table named 'Table: P:\PDOWNS\...'. The table has columns: Total, Invoice, Payment Method, Cc Number, Cc Exp Date, No Of People, Depart Date, and Field. The status bar at the bottom displays the message: 'A value no more than 20 is expected.' Below the table, there are buttons for 'Edit', 'Locked', and 'Field'.

Total	Invoice	Payment Method	Cc Number	Cc Exp Date	No Of People	Depart Date	Field
\$10,245.30	visa		12345 678 90	1/1/2001	2	11/6/92	11/15
\$6,229.50	check				1	4/4/93	4/18/93
\$8,110.00	visa		456456456	9/11/93	4	6/27/93	7/11/93
\$6,142.50	check				3	2/7/93	2/14/93
\$20,731.50	AmEx		432432432	12/31/93	4	5/4/93	5/16/93
\$3,660.30	Cash				1	10/10/93	10/17/93
\$8,011.00	Master Card		1112223334	8/12/93	1	3/15/93	4/12/93
\$8,011.00	AmEx		332332332	12/10/93	99	3/15/93	4/12/93
\$4,159.00	Money Order				2	2/10/93	2/17/93
\$24,338.50	Master Card		122122321	11/9/93	4	3/10/93	3/23/93
\$1,636.00	Cash				1	5/4/93	5/16/93
\$6,235.50	check				2	7/3/93	7/10/93
\$36,350.00	Money Order				6	6/20/93	6/30/93
\$10,343.30	Discover		123123123	12/21/93	2	6/12/93	6/17/93
\$204,562.00	Cash				10	4/2/93	4/24/93
\$9,038.00	check				2	10/1/93	11/1/93
\$4,133.50	Cash				1	2/10/93	2/18/93
\$24,649.00	Money Order				12	4/4/93	4/11/93
\$10,204.00	Money Order				1	2/20/93	3/1/93

Figure 3: You can enforce column integrity in Paradox for Windows by defining a validity check when you define a column. An error message will then appear on the Status bar when a validation error occurs.

DOMAIN INTEGRITY RULES A *domain* is a named object that represents a set of values and certain characteristics that describe those values. For example, you could specify a basic data type, such as character or numeric, and include any integrity rules that are to apply to the domain. Columns would then draw their values from their respective domains.

For example, you could create a domain that represents all the valid state names. You might then create columns based on that domain. The columns would inherit the characteristics of the domain, such as the basic data type and any integrity rules, and would draw their values from the domain. You could then add column integrity rules to go beyond the rules inherited from the domain definition.

Domain integrity rules, then, are those rules defined in the domain definition and inherited by columns based on that domain. The rules themselves are of the same type and variety as those used for column integrity.

Currently, few products include full support for domains and domain integrity. Products that comply with ANSI SQL-92 will support domain integrity through

the check constraint on the CREATE DOMAIN command.

USER-DEFINED INTEGRITY RULES

Any integrity rule other than the types discussed above is classified as a *user-defined integrity rule*. Often integrity constraints of arbitrary complexity are needed to enforce certain business rules. For example, suppose you need to enforce a complex business rule that involves several tables. A different mechanism would be required to support such standalone rules. For this reason, ANSI SQL-92 supports *assertions*—standalone check constraints that are not bound to a particular table or column. You can use assertions to create complex rules that enforce restrictions across multiple tables.

With many of today's products, the only way to enforce rules of arbitrary complexity is to write code using the procedural language that comes with the product. Products that support triggers offer you the opportunity to create arbitrary integrity constraints that are centralized in the database and are invoked automatically. Ideally, then, the database management system you use should be one that provides the maximum declarative support possible and that also supports a trigger mechanism for those rules that simply cannot be specified declaratively.

FURTHER READING For more information about data integrity and the data integrity rules, I recommend the following:

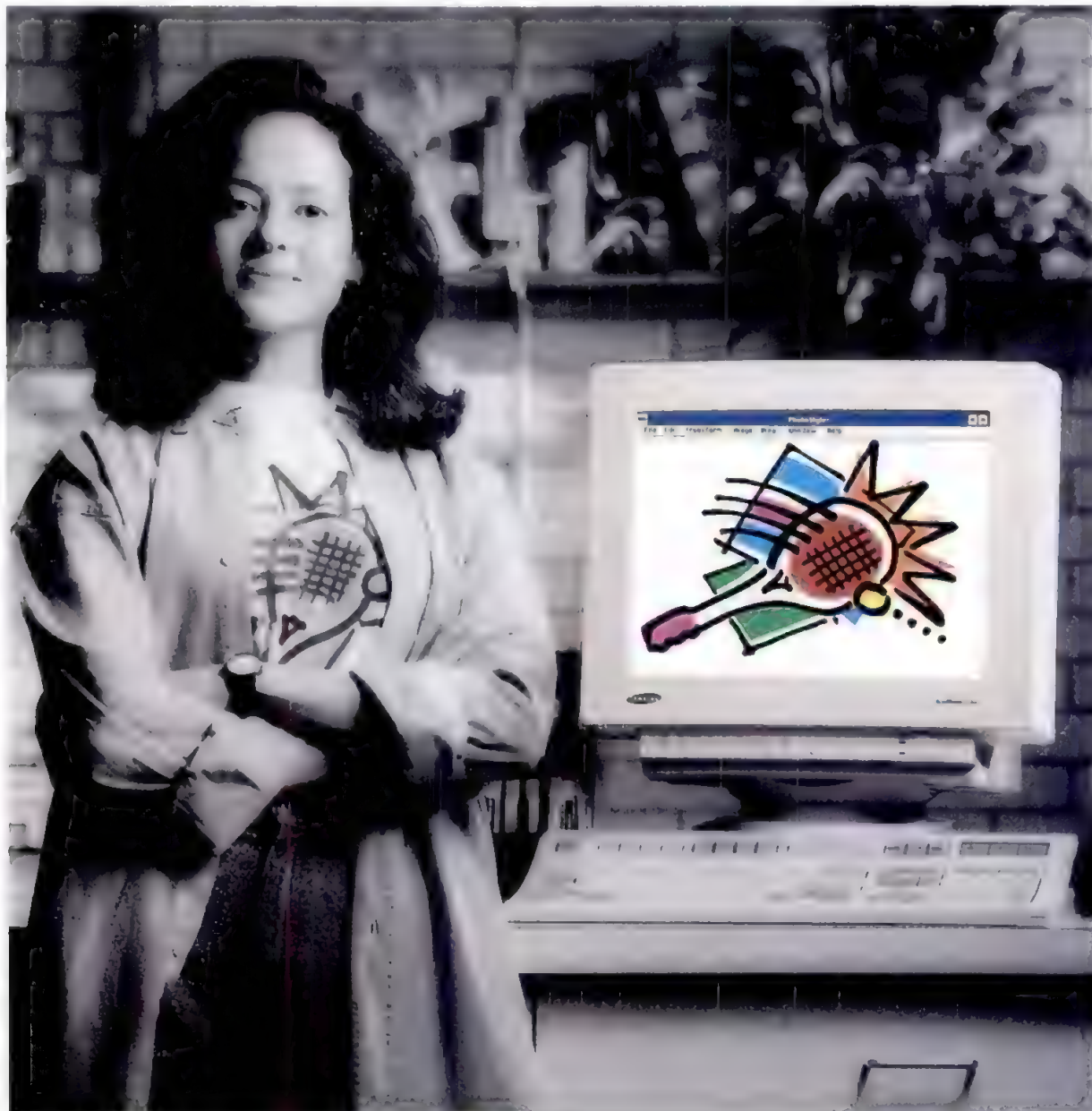
- *The Relational Model for Database Management, Version 2*, by E.F.Codd, Addison-Wesley.
- *An Introduction to Database Systems, Volume I*, 5th edition, by C.J. Date, Addison-Wesley.
- *Understanding the New SQL: A Complete Guide*, by Jim Melton and Alan R. Simon, Morgan Kaufmann. (This book is especially good for SQL-specific information.)

THE MAILBOX Send comments, questions, or suggestions to Sal Ricciardi, contributing editor, via MCI Mail (347-7663) or CompuServe (72241,33). □

SAL RICCIARDI IS A CONTRIBUTING EDITOR OF PC MAGAZINE AND AUTHOR OF THE AWARD-WINNING *RUNNING MICROSOFT FOXPRO FOR WINDOWS* AND *RUNNING MICROSOFT FOXPRO FOR MS-DOS*. BOTH BOOKS ARE PUBLISHED BY MICROSOFT PRESS.

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Power Management	•	•	•	•
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CIRCLE 046 ON READER SERVICE CARD

Toolkits

BY BOB FLANDERS

Make Windows Speak TCP/IP

Protocols are an integral part of computer communications. When you download a file, you use a serial-communications protocol. With NetWare, you use the IPX (Internet Packet Exchange) protocol. And on the Internet, you use Transmission Control Protocol/Internet Protocol, or TCP/IP. Distinct Corp.'s Distinct TCP/IP for Windows, Version 3.20A (\$695), is a software development kit that provides access to TCP/IP from Windows applications.

Distinct TCP/IP is not for neophytes: The product assumes a basic understanding of TCP/IP and the socket programming paradigm used in the Unix environment. You must also have access to a TCP/IP environment. To test Distinct TCP/IP, we set up a point-to-point protocol link with Netcom On-line Communication Services (800-501-8649), a commercial Internet provider.

THREE COMPONENTS Three components make up the Professional Edition: the runtime modules, a set of standard network utilities, and the development kit itself.

Nine network applications are provided; the two most interesting are telnet and FTP (file transfer protocol). Telnet lets you establish a TCP/IP connection with any host running a telnet server; your machine acts as a dumb terminal. When accessing the Internet, telnet lets you communicate with nodes across the hemisphere as cheaply as you'd communicate with nodes in the next room. This is because information is passed locally from computer to computer until it reaches its destination.

FTP lets you connect with an FTP service on a host and transfer files to and from that host. The most impressive capability

of Distinct TCP/IP's FTP program is the ability to transfer a file by dragging it from a list and dropping it on the target directory. The network applications included with Distinct TCP/IP are useful, but they do not come with source code, and you must pay a royalty fee if you distribute them.

The central component of Distinct TCP/IP is the software development kit—the library of API (application programming interface) functions. Distinct TCP/IP provides full TCP/IP support with socket functions plus telnet, FTP, and remote-procedure-call functions.

Socket functions let you establish and terminate sessions and pass datagrams (information packets) among programs running on the network. Two versions are provided. One is implemented according to the Windows interface specification for socket programming; the other is Distinct TCP/IP's own implementation. Although the Distinct TCP/IP API is somewhat faster and uses less memory, if you use the Windows socket API, you can run your program on any TCP/IP implementation that supports the Windows socket specification. If you use the proprietary Distinct

TCP/IP API, you are limited to the Distinct implementation.

TCP/IP's chief strength is its ability to network dissimilar machines. Distinct TCP/IP's support of remote procedure calls (RPC) using external data representation (XDR) exploits this. With RPC, a program can call a routine (or *service*, as it's called in the networking world) on another machine in the network and pass the necessary data as arguments. XDR makes the data machine independent. For example, an Intel-based PC could call a routine on a VAX and pass the data in native Intel format. XDR would reformat the data for use by the VAX system. Then when the VAX finishes the remote procedure call, XDR would reformat the data for use by the PC.

If you need to add TCP/IP capabilities such as Internet access to a Windows program, pick up a copy of Distinct TCP/IP. Although there's a steep learning curve, Distinct TCP/IP provides everything you need to write a TCP/IP application.

Distinct TCP/IP for Windows, Version 3.20A

List price: *Professional Edition* (for C/C++ and Pascal, with application programs), \$695; *Standard Edition* (for C/C++ and Pascal, no application programs), \$495; *Visual Edition* (for Microsoft Visual Basic, no application programs), \$195; *runtime and application tools for 1 user*, \$395; *runtime and application tools for 10 users*, \$1995. Requires: 286-based PC or higher, 4MB RAM, 3MB hard disk space, C/C++ or Pascal compiler or Microsoft Visual Basic, TCP/IP network. Distinct Corp., 12901 Saratoga Ave., Saratoga, CA 95070; 408-366-8933; fax, 408-366-0153.

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OFF THE STACK

● **Pinnacle Publishing's** CommTools for FoxPro, Version 2.0, lets you augment your FoxPro applications with modem, fax, and direct serial communications. The same code can be used with both the DOS and Windows versions of FoxPro. The DOS and Windows libraries are \$299 when sold separately, \$348 for both. *Pinnacle Publishing*; 800-231-1293, 206-251-1900.

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● **Microsoft Corp.'s** Microsoft Access Developer's Toolkit, Version 2.0, offers a variety of add-ins to Microsoft Access 2.0 developers. The toolkit includes tools for application distribution, custom controls for OLE, and user-interface design. It also comes with extensive sample code and technical information. The list price is \$495; for users of Microsoft Visual Basic 3.0, the price is \$395. *Microsoft Corp.*; 800-426-9400.

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Environments

BY CHARLES PETZOLD

The Windows NT Enhanced Metafile

I have a story to tell: During much of 1987, I was working on the first edition of *Programming Windows*, published early the next year by Microsoft Press. Naively, I believed *Programming Windows* would be the first (and perhaps the only) book on the subject. Of course, this was not to be. When my book was about half complete, the very first Windows programming book appeared on the shelves—*Programmer's Guide to Windows*, by David Durant, Geta Carlson, and Paul Yao. I immediately bought the book but could not bring myself to look at it. For almost a month it sat in my apartment in a stapled bag—a scary omen of the proliferation of Windows books to come.

After I finished the chapter in my book on bitmaps and metafiles, curiosity got the better of me. I had just written more about metafiles than I'd ever seen in print, and I wondered how the other authors had tackled the subject. I opened the book, went to the index, and ran my finger down the *Ms*. There was nothing on metafiles, nothing at all. I thrust my fist in the air (a gesture later immortalized by Macaulay Culkin in the *Home Alone* movies) and shouted, "Yes!" I realized the work involved in writing the book was worthwhile after all.

BITMAPS AND METAFILES Like a bitmap, a metafile is used to store visual information, either in a disk file or in memory. Storing visual information allows the interchange of pictures among applications. But there the similarity between bitmaps and metafiles ends.

Metafiles are to vector graphics what bitmaps are to raster graphics. Bitmaps often originate as real-world images cap-

tured through scanners or video frame grabbers. (Bitmaps can also be constructed manually or by program code, of course.) The bitmap stores the image as a series of bits that correspond to the pixels of a display device. In a monochrome bitmap, 1 bit corresponds to 1 pixel. In a color bitmap, multiple bits are required for each pixel.

Metafiles are constructed by humans or computer programs. The metafile consists of a series of records that correspond to graphics function calls; these could be calls to draw straight and curved lines, filled areas, and text. In essence, a metafile is a collection of graphics function calls encoded in binary form.

Paint programs create bitmaps; drawing programs create metafiles. In a drawing program, you can easily grab a particular graphical object (such as a line) and move it somewhere else. That's because the individual components of the picture are stored as separate records. In a paint program, such feats are not possible: You're generally restricted to removing or inserting rectangular chunks of the bitmap.

Because the metafile describes an image in terms of graphics drawing commands, the image can be scaled without loss of resolution. Bitmaps don't work that way. If you display a bitmap at twice its size, you don't get twice the resolution. The bits in the bitmap are just replicated horizontally and vertically.

A metafile can be converted to a bitmap, but information will be lost. The graphics objects that make up the metafile are no longer separate and become blended together as one big image. Converting bitmaps to metafiles is a much more difficult job, usually restricted to very simple images and requiring lots of processing power to analyze edges and outlines.

The extreme dichotomy between raster graphics and vector graphics has bothered me ever since I began graphics programming. This dichotomy is the most obvious example of computer graphics's lack of (to borrow a phrase from physics) a grand unified theory. We simply do not know how to represent visual information in one consistent, all-encompassing manner.

Some progress has been made, however, in merging raster graphics and vector graphics, and the solution seems to involve fractals. While it may be years before we normal programmers can use fractal imaging techniques in our Windows programs, I hope to write about it when the time comes. For now, though,

the topic of discussion is metafiles.

THE WINDOWS METAFILE As I mentioned above, *Programming Windows* contains half a chapter on metafiles. Some additional information on metafiles is also included in the chapter on the Windows Clipboard. I won't bother to repeat that information here;

other work awaits us. As background, however, let's recall that a Windows program creates a metafile by first calling `CreateMetaFile`. The single parameter to this function is either a filename or `NULL`. In the latter case, the function creates a memory-based metafile. The function returns a special device-context handle.

At this point, the program can call various GDI (Graphics Device Interface) functions using the device-context handle returned from `CreateMetaFile`. Binary codes representing these functions and their parameters are accumu-

Because metafiles describe an image in terms of graphical drawing commands, the image can be scaled without loss of resolution.

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CIRCLE 137 ON READER SERVICE CARD

lated in the metafile, either in the disk file or in memory. After making these GDI function calls, the program calls `CloseMetaFile` with the handle to the special device context. This function deletes the device context and returns a handle to the metafile.

The program can display the image encoded in the metafile by calling `PlayMetaFile`. The two parameters to this function are the metafile handle and a handle to the device context on which the image is to be displayed. Because metafiles are GDI objects, the program must eventually delete the metafile by calling `DeleteMetaFile`. This function deletes all the resources in memory required for maintaining the metafile but does not delete the disk file that may have been created. That disk-based metafile may later be retrieved using `GetMetaFile`. `GetMetaFile`'s single parameter is the filename, and the function returns a metafile handle that can be passed to the `PlayMetaFile` function.

A metafile contains a picture defined by all the GDI functions that were called when the metafile was created. Metafiles can be used to transfer pictures between programs, either through disk files or (in the case of memory-based metafiles) through the Clipboard. Indeed, some Windows applications use collections of metafiles as clip art. Because the pictures are defined by GDI function calls rather than bitmaps, they are device independent and can be stretched to whatever size the user requires without losing resolution.

Not all Windows applications that work with vector-based collections of clip art use the Windows metafile format, however. I suppose some manufacturers are simply unwilling to abandon their own proprietary format for storing images. But there's another good reason for not using the Windows metafile format: It just ain't that good.

THE METAFILE PROBLEM Back in the days of Windows 1.x and 2.x, the bitmap format was a mess. The organization of bits in color bitmaps were very closely aligned with actual display devices, severely limiting the bitmaps ability to interchange visual information among applications. The device-independent bitmap (DIB) format introduced in Win-

dows 3.0 was a major step in solving this problem.

The metafile format in Windows 3.1 also dates back to the early days, and it has problems as well. For many years, developers and programmers both within Microsoft and on the outside have been aware of certain flaws in the original design of Windows metafiles. In particular, a program that uses a metafile created by another program cannot easily determine the size of the visual image represented in the metafile. The program would need to go into the metafile and examine all the

*At this stage it appears
that the enhanced metafile
format may do for
Windows metafiles what
DIBs did for
Windows bitmaps.*

.....
drawing commands. This is a big problem. For example, suppose a word processing program had to copy a metafile from the Clipboard and put it between two paragraphs of text. The program wouldn't know where to begin the second paragraph of text if it didn't know the dimensions of the image.

Also, it's highly recommended that metafiles do not contain calls to `SetMapMode` or other functions that change the window/viewport transform. Doing so could make the metafile device dependent or prevent an application from altering the size of the displayed image. Thus, all the coordinates in the metafile are just numbers and are not associated with any particular coordinate system. For this reason, metafiles are not passed directly through the Clipboard. Instead, the Clipboard deals with something called a *metafile picture*. This is a structure of type `METAFILEPICT`. The metafile handle is a field of this structure, as are a mapping-mode identifier (indicating the units of all the coordinates of the GDI function calls encoded in the metafile) and the dimensions of the

image. This information assists the program importing the metafile with setting up the proper GDI environment for displaying the image.

The metafile-picture structure is a classical kludge. It was obviously added to GDI to correct deficiencies in the metafile format. Moreover, a similar facility was not developed for disk-based metafiles, and that's why you don't see a whole lot of them used for interchanging pictures. They're simply too difficult.

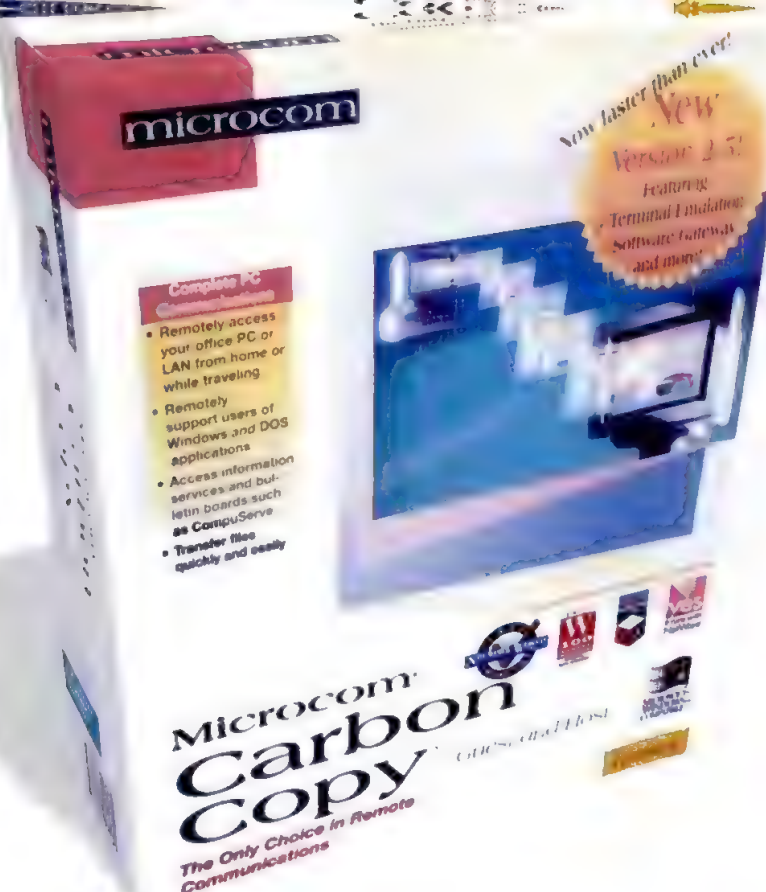
ENTER WINDOWS NT Microsoft has been promising to do something about the metafile problem for a while. A solution has arrived with Microsoft Windows NT. It's called the *enhanced metafile format* (EMF) and is supported with 17 new function calls, a couple of new data structures, a new Clipboard format, and a new filename extension—.EMF.

The most important enhancement is that the new metafile format includes more extensive header information accessible through a function call. This information helps an application display the metafile image. A better header may sound like a no-brainer for file formats, but it's quite welcome.

Some of the new metafile functions included in Windows NT allow you to translate back and forth between the enhanced metafile format and what's now called the Windows metafile format (WMF). Of course, this conversion may not proceed without hitches. As we've seen in recent issues, Windows NT has several new graphics features (such as paths) that have no counterpart in Windows 3.1 and hence no counterpart in the old metafile format.

Windows NT has not yet been put through its paces enough to determine if enhanced metafiles really solve all the problems associated with the earlier format. But at this stage it appears that the EMF format may do for Windows metafiles what DIBs did for Windows bitmaps. It's about time.

THE FIRST PLUNGE One of my pet peeves about the sample programs in Microsoft's development manuals is that they tend to do too much at once, though the tutorials have gotten much better over the years. Nothing today can quite compare with the first sample program in the Microsoft Windows 1.0 Software Devel-



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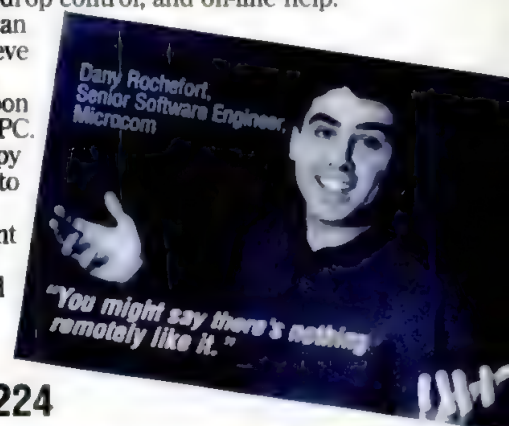
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```
#-----
# EMF1.MAK make file
#-----

#include <ntwin32.mak>

emf1.exe : emf1.obj
    $(link) $(guiflags) -out:emf1.exe emf1.obj $(guilibsmt)

emf1.obj : emf1.c
    $(cc) $(cflags) $(cvarsmt) emf1.c
```

Figure 1: EMF1.MAK facilitates compiling and linking the EMF1 program.

opment Kit. What should have been a simple "Hello, world" program allocated local memory using an undocumented identifier, loaded strings from a resource script, altered the system menu, and invoked a dialog box. That was a bit excessive! In exploring the enhanced metafile, we're going to proceed at a more reasonable pace. Figures 1 and 2 show the EMF1 program, which creates and displays an enhanced metafile with a fairly minimal amount of distractions.

If you have the Microsoft Windows NT Software Development Kit installed, you can create EMF1.EXE by running

NMAKE EMF1.MAK

```
/*-----
EMF1.C -- Enhanced Metafile Demo #1
(c) Charles Petzold, 1994
-----*/

#include <windows.h>

LRESULT CALLBACK WndProc (HWND, UINT, WPARAM, LPARAM) ;

int WINAPI WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "EMF1" ;
    HWND        hwnd ;
    MSG          msg ;
    WNDCLASS     wndclass ;

    wndclass.style = CS_HREDRAW | CS_VREDRAW ;
    wndclass.lpfnWndProc = WndProc ;
    wndclass.cbClsExtra = 0 ;
    wndclass.cbWndExtra = 0 ;
    wndclass.hInstance = hInstance ;
    wndclass.hIcon = LoadIcon (NULL, IDI_APPLICATION) ;
    wndclass.hCursor = LoadCursor (NULL, IDC_ARROW) ;
    wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
    wndclass.lpszMenuName = NULL ;
    wndclass.lpszClassName = szAppName ;

    RegisterClass (&wndclass) ;

    hwnd = CreateWindow (szAppName, "Enhanced Metafile Demo #1",
        WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT,
        CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL) ;

    ShowWindow (hwnd, nCmdShow) ;
    UpdateWindow (hwnd) ;

    while (GetMessage (&msg, NULL, 0, 0))
    {
        TranslateMessage (&msg) ;
        DispatchMessage (&msg) ;
    }
    return msg.wParam ;
}

LRESULT CALLBACK WndProc (HWND hwnd, UINT message, WPARAM wParam,
    LPARAM lParam)
```

on a command line. Or you can download the source code and executable from PC MagNet's Programming Forum (archived as EMF1.ZIP).

During the WM_CREATE

message processing in EMF1's window procedure, the program creates the enhanced metafile, which begins with a call to CreateEnhMetaFile. This function requires four parameters, but you can set all of them to NULL. (How convenient!) I'll discuss how to use these parameters with non-NULL parameters in later columns.

Like CreateMetaFile, the CreateEnhMetaFile function returns a special device-context handle. The program uses this handle to draw a rectangle and two lines connecting the opposite corners of the rectangle. These function calls and their parameters are converted to binary form and stored in the metafile.

Finally, a call to CloseEnhMetaFile wraps up the creation of the enhanced metafile and returns a handle to it stored in a static variable of type HENHMETAFILE.

During the WM_PAINT message, EMF1 obtains the dimensions of the program's client window in a RECT structure. The four fields of the structure are adjusted so that the rectangle is half the width and height of the client window and is centered within it. EMF1 then calls PlayEnhMetaFile. The first parameter to this function is a handle to the window's device context, the second parameter is a handle to the enhanced metafile, and the third parameter is a pointer to the RECT structure.

What happens is that during creation of the metafile, GDI figures out the entire dimensions of the metafile image. In this case, the image is 100 units high and wide. When displaying the metafile, GDI stretches the image to fit the rectangle specified in the PlayEnhMetaFile function. Three instances of EMF1 running under Windows NT are shown in Figure 3.

```
{
    static HENHMETAFILE hemf ;
    HDC        hdc, hdcEMF ;
    PAINTSTRUCT ps ;
    RECT        rect ;

    switch (message)
    {
        case WM_CREATE:
            hdcEMF = CreateEnhMetaFile (NULL, NULL, NULL, NULL) ;

            Rectangle (hdcEMF, 100, 100, 200, 200) ;

            MoveToEx (hdcEMF, 100, 100, NULL) ;
            LineTo (hdcEMF, 200, 200) ;

            MoveToEx (hdcEMF, 200, 100, NULL) ;
            LineTo (hdcEMF, 100, 200) ;

            hemf = CloseEnhMetaFile (hdcEMF) ;

            return 0 ;

        case WM_PAINT:
            hdc = BeginPaint (hwnd, &ps) ;

            GetClientRect (hwnd, &rect) ;

            rect.left = rect.right / 4 ;
            rect.right = 3 * rect.right / 4 ;
            rect.top = rect.bottom / 4 ;
            rect.bottom = 3 * rect.bottom / 4 ;

            PlayEnhMetaFile (hdc, hemf, &rect) ;

            EndPaint (hwnd, &ps) ;
            return 0 ;

        case WM_DESTROY:
            DeleteEnhMetaFile (hemf) ;

            PostQuitMessage (0) ;
            return 0 ;
    }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
}
```



Figure 2: EMF1.C shows a simple approach to creating and displaying a metafile.

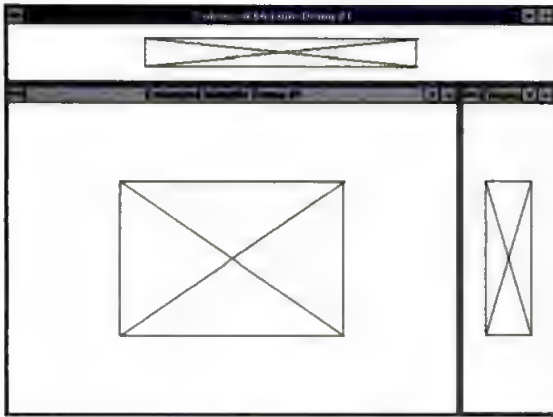


Figure 3: These are three instances of EMF1 running under Microsoft Windows NT.

Finally, during the WM_DESTROY message, EMF1 deletes the metafile by calling `DeleteEnhMetaFile`. Although Windows NT thoroughly cleans up resources when a program terminates, it's always a good idea to get into the habit of cleaning up after yourself.

DEFAULT BEHAVIOR Let's take note of a few things we can learn from the EMF1 program. First, the coordinates used in

the rectangle and line-drawing functions when creating the enhanced metafile don't really mean that much. You can double them all or subtract a constant from them all, and the results will be the same. All that matters is that the coordinates have a relationship among themselves in defining an image.

Second, the image is stretched to fit the rectangle passed to the `PlayEnhMetaFile` function. Thus, the image can be distorted, as Figure 3 clearly shows. The metafile coordinates imply that the image is square, but that's not what we get in the general case.

But sometimes that's exactly what you want. For embedding images in word processing text, you may want the user to specify a rectangle for the image and to be assured that the entire image fits exactly within the rectangle with no wasted space. Let the user worry about the correct aspect ratio by adjusting the rec-

tangle appropriately.

So in terms of default behavior, I like the way the enhanced metafile works. I like it a lot. You specify a rectangle and effectively say, "Put the image right there. Fill up that rectangle entirely but don't leave anything out." There are times, however, when something else is appropriate. You may want to maintain the aspect ratio of the original image, because it may be vitally important to render the exact visual information. For example, a police sketch of a crime suspect shouldn't be fatter or longer than it was originally drawn. Or you may want to preserve the metrical size of the original image. It may be important that the image is 2 inches high and shouldn't be reproduced otherwise.

In future installments of this column, we'll see how to do this. The nice thing about the Windows NT enhanced metafile format is that it gives you enough information to make such adjustments when displaying the image. We'll take a look at the internal format of metafiles in the next column. □

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Power Programming

BY BARRY NANCE

A First Step Toward Client/Server

You rarely hear the words *radical* and *low-risk* in the same sentence, especially when you're talking about converting an application to a client/server architecture. But both terms accurately describe one approach you can take towards converting your own software to client/server. This column explains that approach and can serve as a starting point for switching your application from a file-server orientation to a client/server orientation. I'll give you the basic strategy (which you can adapt to your particular application) and provide code examples (in Borland C) to show how it's done.

In general, you make two changes to your computer programs: First, you modify all the code that performs file I/O operations so that it sends LAN messages (requests for file I/O) over the LAN wire to a central, unattended workstation (known as the *application server*). Next, you write a program to run on the application server. This program receives the LAN messages sent by the other workstations, performs the requested file operation, and returns the result to the workstations. Your modified workstation software expects a response from the application server.

The approach is radical, because in order to share files, your application software now completely bypasses the need for network-operating-system software (such as NetWare, LAN Server, LAN Manager, VINES, or LANtastic) on the LAN. You would share files in the central application server. The workstation portion of your application no longer has to manage file collisions and record locking.

If you encountered bugs or restrictions in the network operating system requiring you to insert workarounds in your software, you can remove those workarounds.

The approach is low risk because it lets you take a gentle first step in the direction of client/server without having to redesign your application completely. People assume that reengineering a software application to take advantage of client/server technology is a complex, time-consuming project. If you use a phased approach in your conversion to client/server, however, you'll find the project quite manageable. This article describes the first phase of converting to client/server.

You can download all the C code functions mentioned in this column from PC MagNet's Programming Forum, archived as NETMES.ZIP.

TURNING FILE I/O INTO LAN MESSAGES

The first step in modifying your application to issue file I/O requests is identifying where your code presently does any kind of file operation. If you've modularized your programs by putting all the file operations inside specialized functions or subroutines that are called by other parts of the program, you're lucky. You know exactly where the code performs file I/O. On the other hand, if your file operations (opening, closing, reading, writing, and seeking) are scattered throughout your source code, you should consider putting those operations into new subroutines and calling the subroutines from the rest

of the application. The changes to your code are strictly structural and shouldn't affect its correct functioning. These changes shouldn't take very long, though you may find the work a bit tedious.

As you identify the file operations, you may find directory-search operations in your code. These usually consist of `findfirst()` and `findnext()` calls. You'll need to include these directory operations in your list, too. You'll convert the `findfirst()` and `findnext()` directory operations into LAN message requests along with the more traditional file operations.

Next, you create a protocol that can handle your file I/O requests and their responses. Creating this protocol is easier than you might think. The bulk of the work is nothing more than designing a record layout (or *message layout*, to be more precise) to carry a file I/O request over the wire to the application server and then designing a record layout to carry the response from the application server back

If you use a phased approach in your conversion to client/server, you'll find the project quite manageable.

to the workstation. For example, your protocol can use the first byte of the message to indicate which file operation the request is for (you can name this field `RequestID` or something similar). Subsequent bytes provide information about a particular file operation. A

request to open a file might use a `RequestID` value of 1, while a request to read a portion of a file might use a `RequestID` of 6. You can assign the values arbitrarily. Just make sure you have a request-message layout for each type of file operation your program needs to do. The response message from the application server can use a `ResponseID` first byte that corresponds to the `RequestID`. You'll want to design each response message to carry a `Return Code` field, too.

For each open-file request, the body of the message record after `RequestID` can hold the name of the file and perhaps a mode indicator that distinguishes between raw (binary) and text-mode file types. An open-file response message should hold a `FileReferenceNumber` field in addition to the `ResponseID` and `ReturnCode` fields.

You can use the FileReferenceNumber field in the same way your program would have used the file handle returned by DOS, OS/2, or the network software when you opened a file. In this case, however, your software running on the application server assigns FileReferenceNumber values. Note that the contents of both the request and the response message records closely parallel the purpose of the parameters you use when you code an fopen() or open() call in your program.

For a read-file request, the body of the message uses FileReferenceNumber to specify which file to read. The read-file request message also contains a NumberOfBytes field telling how many bytes to read. If your software reads or writes more than 512 bytes

at a time, you'll need to do some extra work: LAN messages have size limitations you must adhere to. The sidebar "Segmenting Write Requests and Read Responses" explains

a simple segmentation technique you can use to fit blocks of file material into LAN messages.

In addition to ReturnCode, a read-response message contains the requested file data and a NumberOfBytes field that tells how many bytes were read. Write requests and responses work in a similar manner. The write request contains the file material that the workstation wants to store along with a NumberOfBytes (to be written) field. The write response holds a ReturnCode field and a NumberOfBytes (actually written) field. A close-file request merely contains the FileReferenceNumber. The response needs to convey only ReturnCode from the application server back to the workstation.

Don't be confused by this discussion about designing your own protocol for performing over-the-wire file operations. Just keep in mind the basic idea that you're turning parameters for functions such as fopen(), open(), fread(), or fseek() into fields stored in LAN messages and that you send those LAN messages from workstation to the application server and back again. Design your request/response protocol to satisfy the

types of file operations your software performs, and you'll be ready to begin changing your computer programs to use the new protocol.

THE MESSAGE-PASSING MECHANISMS Sending and receiving LAN messages is easy. You can choose from a variety of message-passing mechanisms (called *transport layer protocols*). You might use the Internet Packet Exchange (IPX), commonly found on Novell's NetWare LANs. LAN Manager, LAN Server, LANtastic, Microsoft Windows for Workgroups, and Microsoft Windows NT Advanced Server use NetBIOS to move messages over the LAN wire. Transmission Control Protocol/Internet Protocol (TCP/IP) is popular on LANs connecting Unix-based comput-

```
int IPXInstalled(void) {
    union REGS regs;

    regs.x.ax = 0x7a00;
    int86(0x2f, &regs, &regs);
    if (regs.h.al != 0xff) return 0; /* IPX not available */

    return 1; /* IPX available */
}
```

Figure 1: This little C function tests for the presence of IPX.

ers. Advanced Program-to-Program Communications (APPC), the LU 6.2 component of IBM's Systems Network Architecture (SNA), is yet another mechanism you might choose.

IPX is available on most LANs because market-leading NetWare uses IPX. While IPX packets can be up to only 546 bytes and IPX programming requires somewhat lower-level programming effort than other transport mechanisms, IPX is an excellent performer. NetBIOS datagrams can be up to 512 bytes, but session-based NetBIOS messages can be up to 64K; I discuss datagrams in this article, however, because they're simpler to program. NetBIOS doesn't generally perform quite as well as IPX but is easier to program (you code at a higher level than for IPX). APPC is so easy to program (through IBM's SAA-compliant CPI-C libraries) that performance may not be a consideration. This article describes IPX and NetBIOS. Note that you might go the extra step and support more than one message-passing mechanism in your code. Besides showing you how to send and receive IPX and NetBIOS messages, I'll also explain how to detect whether IPX or

NetBIOS is present.

IPX messages and NetBIOS datagrams are connectionless, and the transport layer of the network software does not guarantee delivery of messages in a connectionless environment. To compensate for this problem, you can add retry logic to your code. You can think of the retry logic in terms of the protocol you've designed. Every request that's sent should result in a response. If the sender doesn't get a response within a time period you specify (you might use 0.5 second or perhaps 1 second), the sender of the request can reissue the request. By the same token, if the application server gets duplicate requests, it can simply resend the response. Dropped messages happen very infrequently on a

LAN, so you don't have to worry about performance degradation. But you do have to consider that an occasional message might not appear at its destination. You can insert a Mes-

sageNumber sequence field in your protocol's message layouts so that your software can detect duplicate messages. Just increment MessageNumber for each message record you send.

To test for the presence of IPX on a DOS-based machine, put 7A00 (hexadecimal) into the AX CPU register and issue interrupt 2F. If the AL register contains FF after the call, IPX is available. If you program in C, you can use the code in Figure 1. The test for NetBIOS involves the use of a Network Control Block (NCB), a structure of fields you use to tell NetBIOS what to do. You can use the NCB definition shown in Figure 2. You first make sure that an interrupt vector exists for interrupt 5C, the NetBIOS entry point. You then pass NetBIOS an NCB containing an invalid command and expect back a NetBIOS "bad command" return-code value of 3, as detailed in Figure 3.

USING IPX To use IPX on a DOS-based PC, you invoke interrupt 7A. IPX provides functions for opening a *socket*, sending and receiving messages through the open socket, closing the socket, and relinquishing some processing time to IPX so that IPX can execute in the back-

ground. (You can think of a socket as a port, similar to COM1 or LPT1. You can have several sockets open at the same time.) Figure 4 shows how to invoke IPX functions. Figure 5 illustrates an Event Control Block (ECB) and the IPX header with which you prefix each IPX message you send. (As we'll see later, you use ECBs with IPX similarly to the way you use NCBs with NetBIOS.)

The normal sequence of events for using IPX is opening a socket with `IpxOpenSocket()`, issuing an `IpxListen()`, sending a message with `IpxSend()`, and later closing with an `IpxCloseSocket()`. Note that when you're about to send a message and expect a response message to come back to the program, you should issue the `IpxListen()` before sending the message. In terms of the protocol you've designed to carry your file requests, this means your program issues the `IpxListen()` that will receive the file I/O response before the program sends the file I/O request with an `IpxSend()` call.

You should open two sockets: one for receiving messages and one for sending messages. Because NetWare reverses the order of the 2 bytes of the socket value you assign, you'll likely want to use socket values such as 2323h and 2424h to avoid confusion between what you specify and how NetWare treats the socket number.

When you call `IpxSend()` to send a message record, you need to set up the ECB and IPX header fields. The fields in the ECB structure control the sending of the message, and the IPX header becomes the first 30 bytes of the message you send. Send operations and receive operations should use different ECB and IPX header pairs: one pair with the names

```
void NetBios(NCB *ncb_ptr) {
    _ES = FP_SEG( (void far *) ncb_ptr);
    _BX = FP_OFF( (void far *) ncb_ptr);
    _AX = 0x0100;
    geninterrupt(0x5c);
}

int IsNetBIOS(void) {
    int_5C_vector = getvect(0x5C);
    if (int_5C_vector == NULL)
        return 0; /* NetBIOS not loaded */

    WorkNCB.NCB_COMMAND = 0x7F; /* 7F is an invalid command */
    NetBios(&WorkNCB);
    if (WorkNCB.NCB_RETCODE != 03) /* 3 means invalid command */
        return 0; /* NetBIOS not loaded */

    return 1; } /* NetBIOS is present */
```



Figure 3: This C function uses a Network Control Block to test for the presence of NetBIOS.

`SendECB` and `SendHeader` and the other pair with the names `ReceiveECB` and `ReceiveHeader`. Initialize the `SendECB` and `SendHeader` to 0s, and then insert the send socket number into the `SendECB`. Set the `SendECB`'s `packet_count` field to 2, and then use the address and length fields of the packet array in the `SendECB` to specify two data areas. The first data area is the IPX header, and the second is the message you want to send, as `IpxSend()` in Figure 4 shows. The `IpxSend()` function makes the ES and SI registers point to `SendECB`, sets the BX register to 3, and issues interrupt 7A to send the message.

You can send IPX messages to a particular network number (4 bytes), node number (6 bytes), and socket. You can also broadcast IPX packets to all stations on the LAN by putting 6 FF bytes in the `dest_network_node` field of the IPX header. You can use the IPX broadcast feature to your advantage: Devise a scheme so that when your application first begins running, it broadcasts a request asking your applica-

tion server to identify itself. The `source_network_number` and `source_network_node` fields of the response's IPX header will contain the specific LAN address of the application server.

To receive an IPX message, initialize the `ReceiveECB` and `ReceiveHeader` data areas to 0s. Set the `ReceiveECB`'s `socket_number` field to the value you chose (perhaps 2424h) to receive messages. Set the `packet_number` field in the `ReceiveECB` to 2 and use the address and length fields of the packet array to specify your `ReceiveHeader` data area and the `ReceiveMessage` data area, just as you did for sending a message. Then make the ES:SI register pair point to your `ReceiveECB`, put 4 in the BX register, and invoke interrupt 7A to ask IPX to listen for an incoming message. IPX sets the `in_use` field of your `ReceiveECB` and returns control of the CPU to your program. You can then create your file I/O request message and use `IpxSend()` to deliver the request to the application server. You know that you have a response message to process when the `in_use` field becomes 0 and the `completion_code` in the `ReceiveECB` is also 0.

While your program waits for a response (waiting for the `in_use` field to become 0), IPX needs some CPU processing time to handle the incoming message. Until the `in_use` field becomes 0, you can call the `LetIpxBreathe()` function shown in Figure 4 to let IPX do its work.

USING NETBIOS Programming for NetBIOS is easier than for IPX, because NetBIOS operates at a higher level than IPX. Figure 6 shows the most useful NetBIOS functions. Note that the functions in Fig-

```
typedef unsigned char byte;
typedef unsigned int word;
typedef struct {
    byte NCB_COMMAND; /*command id */
    byte NCB_RETCODE; /*immediate return code */
    byte NCB_LSN; /*local session number */
    byte NCB_NUM; /*network name number */
    void far *NCB_BUFFER_PTR; /*address of message packet */
    word NCB_LENGTH; /*length of message packet */
    byte NCB_CALLNAME[16]; /*name of the other computer */
    byte NCB_NAME[16]; /*our network name */
    byte NCB_RTO; /*receive time-out in 500 ms. incrs. */
    byte NCB_STO; /*send time-out in 500 ms. increments*/
    void interrupt (*POST_FUNC)(void); /*address of POST routine */
    byte NCB_LANA_NUM; /*adapter number (0 or 1) */
    byte NCB_CMD_CPLT; /*final return code */
    byte NCB_RESERVE[14]; /*Reserved area */
} NCB;
```

Figure 2: This is the format of a Network Control Block.

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Suspend/Resume Support	✓	No
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■ Segmenting Write Requests and Read Responses

The largest physical message record you can send using a Token-Ring network is about 4K on a 4-megabit-per-second LAN and about 17K on a 16-mbps LAN. Ethernet messages can be up to about 1,500 bytes. The message-sending protocol IPX, which Novell's NetWare uses, can send up to 4K through some network adapters but only 546 bytes through most adapters. The NetBIOS SendData-

gram function can send at most 512 bytes. The maximum size of an LU 6.2 (Advanced Program-to-Program Communications, or APPC) message is about 32K.

With these limits in mind, how do you handle write requests and read responses involving large blocks of data? The answer is segmentation. Whenever you have several message records worth of data, you send a series

of messages to the other computer. You can expand the layout of your request and response messages to carry an additional Sequence-Number field and a TotalNumberOfMessages field, and you can calculate the values for these fields as you send the series of messages. These fields will let the receiving computer know to expect, for example, a message record one of three, two of three, and three of three.

Figure 6 call the NetBIOS() function in Figure 3 to invoke NetBIOS. The NetBIOS() function in turn issues an interrupt 5C to give an NCB to NetBIOS for processing.

To begin using NetBIOS, add a unique-across-the-LAN name to the NetBIOS name table. The name can be up to 15 letters and numbers and should be right-padded with spaces. You insert a null (0) byte in the 16th position of the name and then call the AddName() function. NetBIOS assigns a name number (NCB_NUM in the Network Control Block), which you use to send and receive NetBIOS datagram messages. When your application terminates and you're finished using NetBIOS, call the DeleteName() function to delete the name from the NetBIOS name table.

Before sending a request for which you expect a response, you should call the ReceiveMessage() function, which tells NetBIOS to listen for an incoming message. Just as with IPX, having a receive

operation outstanding at the time you send a message is a good idea. The return response might come back before you have time to issue the ReceiveMessage() call. To receive a message for the name you added to the NetBIOS name table, specify the name number (assigned by NetBIOS when you performed the AddName() call) as the first parameter to ReceiveMessage(). The packet_ptr and packet_len parameters are the address and length of the data area into which you will receive the response message. You have a response message to process when NetBIOS changes the NCB_CMD_CPLT field in the NCB from FF to 0.

You refer to the destination computer on the LAN by name when you send NetBIOS datagram message records. The name you specify is the same one added to the NetBIOS name table by the program running on the other computer. The SendMessage() function takes four parameters. The destination parameter is the

name of the computer to which you want to send the message. The name_num parameter is the name number that you got back from the AddName() call. The packet_ptr and packet_len parameters express the address and length of the message record you want to send.

At this point, you've gotten a thumbnail sketch of IPX and NetBIOS programming. If you're curious and want to learn more about these message-passing mechanisms, you might want to get Novell's *NetWare System Calls—DOS* technical manual for IPX, IBM's *Local Area Network Technical Reference* for NetBIOS, or my *Network Programming in C* (which covers both IPX and NetBIOS). You should, however, find this article sufficient to begin doing IPX and NetBIOS programming for your client/server conversion project.

DESIGNING THE APPLICATION SERVER

So far, the discussion on sending and receiving redirected file I/O messages—the

```
int IpxOpenSocket(unsigned int socket) {
    _DX = socket;
    _BX = 0x0000;
    _AL = 0xFF;
    geninterrupt(0x7a);
    _AH = 0;
    return _AX;
}

void IpxCloseSocket(unsigned int socket) {
    _BX = 0x0001;
    _DX = socket;
    geninterrupt(0x7a);
}

void LetIpxBreathe(void) {
    _BX = 0x000A;
    geninterrupt(0x7a);
}

void IpxListen(void) {
    memset(&ReceiveECB, 0, sizeof(ECB));
    memset(&ReceiveHeader, 0, sizeof(IPXHEADER));
    ReceiveECB.socket_number = 0x2424;
    ReceiveECB.packet_count = 2;
    ReceiveECB.packet[0].address = (void far *) &ReceiveHeader;
    ReceiveECB.packet[0].length = sizeof(IPXHEADER);
    ReceiveECB.packet[1].address = (void far *) &ReceiveMessage;
    ReceiveECB.packet[1].length = sizeof(ReceiveMessage);
}
```

```
_ES = FP_SEG( (void far *) &ReceiveECB);
_SI = FP_OFF( (void far *) &ReceiveECB);
_BX = 0x0004;
geninterrupt(0x7a);
}

void IpxSend(void) {
    memset(&SendECB, 0, sizeof(ECB));
    memset(&SendHeader, 0, sizeof(IPXHEADER));
    SendECB.socket_number = 0x2323;
    SendECB.packet_count = 2;
    SendECB.packet[0].address = (void far *) &SendHeader;
    SendECB.packet[0].length = sizeof(IPXHEADER);
    SendECB.packet[1].address = (void far *) &MessageToSend;
    SendECB.packet[1].length = sizeof(MessageToSend);
    SendHeader.packet_type = 4;
    memcpy(SendHeader.dest_network_number, network, 4);
    memcpy(SendHeader.dest_network_node, node, 6);
    SendHeader.dest_network_socket = 0x2424;

    _ES = FP_SEG( (void far *) &SendECB);
    _SI = FP_OFF( (void far *) &SendECB);
    _BX = 0x0003;
    geninterrupt(0x7a);
}
```

Figure 4: These are the functions you use to send and receive messages when using IPX.




```
typedef struct {
    void far *link_address;
    void far (*event_service_routine)(void);
    unsigned char in_use;
    unsigned char completion_code;
    unsigned int socket_number;
    unsigned int connection_id;
    unsigned int rest_of_workspace;
    unsigned char driver_workspace [12];
    unsigned char immediate_address [ 6];
    unsigned int packet_count;
    struct {
        void far *address;
        unsigned int length;
    } packet [2];
} ECB;

typedef struct {
    unsigned int checksum;
    unsigned int length;
    unsigned char transport_control;
    unsigned char packet_type;
    unsigned char dest_network_number [4];
    unsigned char dest_network_node [6];
    unsigned int dest_network_socket;
    unsigned char source_network_number [4];
    unsigned char source_network_node [6];
    unsigned int source_network_socket;
} IPXHEADER;
```

Figure 5: This is the Event Control Block (ECB) and the IPX header.

requests and responses you've designed to handle your application's I/O—has revolved around the client PC. You have a basic understanding of how the client makes requests of the application server, and you've designed a protocol that lays out the fields in the request and response message records. You next need to consider what will happen in the application-server program you'll write.

For each request message received, the application server performs the I/O operation on behalf of the client. Acting almost as a file server, the application server listens continuously for incoming requests from client, decodes each request to determine what I/O operation to perform, and sends responses back to the clients. You can use the same IPX and NetBIOS functions in your application server as you used in your modified client software.

The application server should always have at least one receive operation outstanding. You might design your server program to issue several receive operations, because the application server is bound to be one busy PC during much of the work day. As you gain experience with the application server, you might even want to switch to a different application-server operating system (such as OS/2) that lets you take advantage of features such as multithreading and the High Performance File System (HPFS).

THE BENEFITS OF THIS APPROACH

Once you've adapted your application so that it uses the approach outlined in this article, you've taken a first step toward client/server architecture. You've separated your application from the file server, and you can still share files in a multiuser environment. Workstation software no longer has to detect the presence of SHARE.EXE (which enables file sharing). If people run your software on LAN Server, LANtastic, and NetWare networks, you no longer have to worry about the differences and idiosyncrasies of these different network operating systems. While you might have some influence over how much disk space a file server has or how powerful the file-server computer is, you now have complete control over the management and selection of the computer on which your application server runs. And best of all, you can begin thinking about the next phase of your conversion to client/server—a phase in which you consolidate and redesign your application's I/O to happen at a higher level between client and application server.

DISADVANTAGES If you don't go beyond the rudimentary file redirection described in this article by creating a client/server architecture that operates at a higher level, you won't have a bad situation, but neither will you have an ideal one. You'll simply have substituted your

own application-specific code for the general-purpose network-operating-system code. LAN Server and NetWare represent highly optimized file-sharing contexts; you may find that the application server responds more slowly than you'd like, and you're faced with an immediate port of the application server to a multi-threaded OS/2 machine.

Depending on the level of security your application demands, you may find you need to augment your design with security considerations. Because you're no longer within the security framework of a network operating system, you may need to do the extra work of establishing log-on accounts, secret passwords, and permissions.

A STEP FORWARD Converting an application to be fully client/server is usually a difficult project. The approach this article describes can allow you to take a first step in the direction of client/server. It's radical, but you'll find the risks are less than if you try to convert all at once. □

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```
void AddName(char *name) {
    memset(&add_name_ncb, 0, sizeof(NCB));
    add_name_ncb.NCB_COMMAND = 0x30; /* 0x30 = Add Name */
    strcpy(add_name_ncb.NCB_NAME, name);
    NetBios(&add_name_ncb);
}

void DeleteName(char *name) {
    memset(&delete_name_ncb, 0, sizeof(NCB));
    delete_name_ncb.NCB_COMMAND = 0x31; /* 0x31 = Delete Name */
    strcpy(delete_name_ncb.NCB_NAME, name);
    NetBios(&delete_name_ncb);
}

void ReceiveMessage(unsigned char name_num,
    void *packet_ptr, int packet_len) {
    memset(&receive_ncb, 0, sizeof(NCB));
    receive_ncb.NCB_COMMAND = 0xA1; /* 0xA1 = Receive Msg */
    receive_ncb.NCB_NUM = name_num;

    receive_ncb.NCB_LENGTH = packet_len;
    receive_ncb.NCB_BUFFER_PTR = (void far *) packet_ptr;
    NetBios(&receive_ncb);
}

void SendMessage(char *destination,
    unsigned char name_num,
    void *packet_ptr,
    int packet_len) {
    memset(&send_ncb, 0, sizeof(NCB));
    send_ncb.NCB_COMMAND = 0xA0; /* 0xA0 = Send Msg */
    send_ncb.NCB_NUM = name_num;
    strcpy(send_ncb.NCB_CALLNAME, destination);
    send_ncb.NCB_LENGTH = packet_len;
    send_ncb.NCB_BUFFER_PTR = (void far *) packet_ptr;
    NetBios(&send_ncb);
}
```

Figure 6: These are the functions you use to send and receive datagram messages under NetBIOS.



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Utilities

BY MICHAEL HOLMES AND BOB FLANDERS

Copy Disks Fast With QUIKCOPY

Until very recently, computers could typically hold more information on a floppy disk than they could store in memory. As a result, you had to do the "floppy-disk shuffle" when copying one disk to another. The DISKCOPY command that comes with DOS 6.2 provides some relief, but that doesn't help people who use previous versions of DOS.

This issue's utility, QUIKCOPY, gives you the one-pass copying of DOS 6.2's DISKCOPY, but it works a bit differently. First, it uses extended or expanded memory to hold the source-disk information. In fact, QUIKCOPY can be used only if you have enough extended or expanded memory to hold the contents of the disk you want to copy. Second, though QUIKCOPY can copy disks in any format, it's especially fast when copying standard DOS-formatted disks. This is because DISKCOPY omits unused sectors, which can drastically improve speed and reduce memory requirements when there are few files on the disk. Finally, QUIKCOPY displays progress statistics as it copies, so you know how much more work is left.

QUIKCOPY and its C language source code can be obtained by mail or by downloading the files archived as QUIKCO.ZIP from PC MagNet's Utilities/Tips Forum. Refer to the sidebar "Guide to Our Utilities & How to Get Them" for the details.

USING QUIKCOPY To see QUIKCOPY's full command syntax, type QUIKCOPY with no arguments at the DOS prompt. This will display the program's copyright banner and a help mes-

sage describing its syntax. The syntax for the QUIKCOPY command is

```
QUIKCOPY source-drive [target-drive]
[/1] [/A]
```

The *source-drive* parameter names the drive containing the disk that QUIKCOPY will copy. The *target-drive* parameter names the drive containing the disk to which QUIKCOPY will write. The /1 parameter tells QUIKCOPY that you want to make only one copy of the source disk when; when you use it you will not be prompted to change target disks after the first copy is completed.

The only parameter required by QUIKCOPY is *source-drive*. When you specify only the *source-drive* argument, QUIKCOPY assumes that you want to use the same drive as the source and as the target. It copies the contents of the disk in the source drive to memory,

prompts you to replace the source disk with a target disk, and writes the data to the target. QUIKCOPY will then repeatedly prompt for additional target disks until you press the Esc key.

In a system where you have two floppy disk drives of the same size, you could place the source disk in drive A:, place the target in drive B:, and issue the command

```
QUIKCOPY A: B:
```

Like DISKCOPY, QUIKCOPY restricts you to copying data between disks of like format—1.2MB to 1.2MB, 1.44MB to 1.44MB, and so on.

QUIKCOPY views disks as one of two types: DOS disks and non-DOS disks. DOS disks—disks formatted with DOS's FORMAT command or with a compatible program—contain an identifiable structure. Any disk without this structure is a non-DOS disk.

When QUIKCOPY reads the source disk, it examines the disk structure to determine whether the disk is DOS or non-DOS. Then, based on its findings, QUIKCOPY uses one of two copy algorithms: a used-cluster algorithm, where only the portions of the disk marked by DOS as used are copied, or a sector algorithm, which copies all sectors regardless of what is stored there. We'll look more closely at these algorithms later.

If a disk contains few files, copying only used clusters is much faster. But if you choose, you can use the /A switch to force QUIKCOPY to use the sector algorithm. This is the method that DOS's DISKCOPY command uses and will give you an exact duplicate of the original disk.

QUIKCOPY will terminate when it encounters any error reading the source disk, with the natural exception of the drive-not-ready messages it receives before the source disk has been placed into the drive. After QUIKCOPY detects that you've inserted a disk, any further drive-not-ready messages could indicate that the disk has been changed, so the copy process will be aborted.

CREATING THE COPY Before writing a target disk, QUIKCOPY first attempts to read the target to determine whether the disk must be formatted. If QUIKCOPY cannot read the disk, it will format the disk before writing the data. If QUIK-

Top 10 Utilities

Rank	Utility
1	FINDIR - Locates available IRQs
2	WTIME - Keeps PC clock accurate
3	MONITOR - Monitors system resources
4	INCTRL - Controls Windows' installation
5	BAT2EX - Compiles batch files
6	PRUNE - Manages DOS files
7	SWTCH - Creates multiple Windows setups
8	BUGS - Windows 3.1 screen saver
9	THINDI - Streamlines hard disk
10	MBOOT - Multiple boot program

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."


```
C:\>quikcopy a: /1
QUIKCOPY 1.00 ** Copyright (c) 1994, Michael Holmes and Bob
Flanders
First published in PC Magazine, August 1994 • 1 Pass Disk Copy
```

```
Drive A: [DOS] Copying used clusters
Volume Id: Label: TESTQUIK Serial: 2E50-15F0
Disk Info: 2880 Sectors, 2847 Clusters, 512 Clustersize
Capacity: 1.44mb, 1.43mb used, 1kb available
Storing: 2859 sectors using 1.42mb of XMS memory
Status: Reading Cyl 31, Head 0 38.3% .....
```

Figure 1: QUIKCOPY displays significantly more information than DISKCOPY about the disk being copied and the progress of the operation.

```
C:\>quikcopy a: /1
QUIKCOPY 1.00 **
Copyright (c) 1994, Michael Holmes and Bob Flanders
First published in PC Magazine, August 1994 • 1 Pass Disk Copy
```

```
Drive A: [DOS] Copying used clusters
Volume Id: Label: TESTQUIK Serial: 2E50-15F0
Disk Info: 2880 Sectors, 2847 Clusters, 512 Clustersize
Capacity: 1.44mb, 1.43mb used, 1kb available
Storing: 2859 sectors using 1.42mb of XMS memory
Finished: 2873 total sectors written
Timing: 23kb/sec reading, 22kb/sec writing
Copies: 1 made using drive A:
```

Figure 2: Upon completion, QUIKCOPY displays additional statistics, noting the amount of data copied and the performance of the hardware.

COPY can initially read the disk, it will not be formatted, even if I/O errors occur later while writing to the disk.

If QUIKCOPY encounters errors when writing a target disk, QUIKCOPY asks for another disk. There are several errors that can cause QUIKCOPY to reject a disk. As you might expect, a bad disk will be rejected, but there are some less obvious conditions that will cause a disk to be rejected, too.

The first is a mismatched-capacity error. If a preformatted target has a different capacity from the source disk, QUIKCOPY rejects the disk and waits for another to be inserted into the drive. Also, when QUIKCOPY uses the used-cluster algorithm, the target disk must have no bad clusters occupying space that was in use on the source disk. For example, if cluster 100 on the source disk is in use by a file and the target's cluster 100 is a bad cluster according to its FAT (file allocation table), QUIKCOPY rejects the target disk. (With the sector strategy, any disk with a bad sector will be rejected when a hardware-write error occurs.)

Unlike DOS's DISKCOPY command, QUIKCOPY reports its progress as it copies the disk (see Figure 1). First, when the program is launched, QUIKCOPY displays such information about the source

from a solid block to a dot. When the entire bar has changed to dots, the operation is complete. QUIKCOPY updates the progress chart every second.

When QUIKCOPY finishes writing the last disk, it issues a final report showing various statistics gathered during the copy (see Figure 2). The report displays the number of sectors written, the number of disks written, and the data-transfer rates in bytes per second for reading, writing, and formatting.

USING THE SECTOR ALGORITHM When using the sector method to copy, QUIKCOPY simply reads every track on the disk and moves the data to extended memory. Then QUIKCOPY retrieves the data from extended memory and writes the tracks to the target disk.

QUIKCOPY uses this technique to make exact duplicates of DOS disks or to copy disks that are not DOS-formatted, but the disks must have the physical characteristics required by DOS (see Figure 3). If QUIKCOPY cannot verify that a disk is one of these physical types, it displays an error message and terminates.

For example, a 1.44MB, 3.5-inch disk contains tracks with 18 sectors per track, and a 1.2MB,

disk as the disk label and capacity, along with the amount of memory needed, the type of copy algorithm employed, and other related information. Then, as QUIKCOPY performs each operation (reading, writing, or formatting), it tells you what proportion of the operation has been completed. Along with this percentage is a visual display in the form of a simple bar. As the program progresses, QUIKCOPY transforms each character in the bar

5.25-inch disk contains tracks with 15 sectors per track. QUIKCOPY will not copy a disk with, for example, 17 sectors per track. When presented with such a disk, QUIKCOPY would attempt to read the first track on the disk with 18 sectors. Since there are only 17 sectors per track, the attempt would fail. QUIKCOPY would then attempt to read the disk with the next lower value, 15 sectors per track. Since there are 17 sectors, the operation would complete successfully.

Next, to verify that the disk contains only 15 sectors, QUIKCOPY will attempt to read in a 16th sector. If the read attempt succeeds, QUIKCOPY issues a message indicating that the disk contains an unsupported format and terminates.

DECODING THE DISK QUIKCOPY contains several unusual and interesting operations not often found in utility programs. We'll look at two of these operations in greater detail: a method for determining whether a disk is DOS formatted and a method for calculating physical disk addresses for low-level disk I/O (writing sectors and clusters rather than files).

Every DOS disk contains four structures: the boot sector, the FAT, the root directory, and the data area. When using the sector algorithm, QUIKCOPY disregards these areas since it makes no assumptions about the structure of the disk. When using the used-cluster algorithm, however, QUIKCOPY uses information contained in two of the structures: the boot sector and the FAT.

On DOS disks, the very first sector is the boot sector, which contains vital disk information such as the size of a sector, the number of sectors, the length of the FAT, and so on (see Figure 4). QUIK-

Disk Types Recognized by DOS

Media descriptor	Drive size	Capacity	Heads	Sectors per track	Tracks per disk
0xF0	3.5"	1.44MB	2	18	80
0xF9	3.5" or 5.25"	720K	2	9	80
	5.25"	1.2MB	2	15	80
0xFD	5.25"	360K	2	9	40
0xFF	5.25"	320K	2	8	40
0xFC	5.25"	180K	1	9	40
0xFE	5.25"	160K	1	8	40

Figure 3: Only these physical disk characteristics are recognized by DOS. DOS notes the disk type in the boot sector's media descriptor byte and in the first byte of the FAT.



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```

struct boot_rec          // boot record
{
    char jmp[3],          // jump instruction
    oem_name[8];          // OEM name
    UINT bytes_per_cluster; // bytes per sector
    char sector_per_cluster; // sectors per cluster
    UINT res_sectors;      // reserved sectors
    char fats;             // number of fats
    UINT root_dir_ents,    // nbr of root dir entries
    sectors;              // total sectors
    char media;            // media descriptor byte
    UINT fat_sectors,      // sectors per fat
    sectors_per_track,    // sectors per track
    heads;                // number of heads
    long hidden_sectors,   // hidden sectors
    huge_sectors;         // sectors if above 32Mb
};

```

Figure 4: The boot sector stores vital disk information in this structure.

COPY uses the boot sector to determine whether a disk is DOS formatted. Also, when copying a disk, QUIKCOPY uses the boot record to check FAT size, number of FATs, reserved sectors, number of sectors, and sectors per cluster.

IS IT A DOS DISK? When started without the /A switch, QUIKCOPY first checks whether the disk is DOS formatted. This is done by treating the first sector as if it were a valid boot sector and checking the values stored there (see Figure 5). If any of the values is invalid, it is not a DOS disk. Since pure chance could yield a valid value, however, when a valid value is found, QUIKCOPY goes on to check other boot-sector fields. The odds that sheer chance would result in a completely valid boot sector are impossibly low.

QUIKCOPY starts by checking the

value contained in the media descriptor byte in the boot record. DOS also stores this value as the first byte of the FAT. If the media descriptor contains a valid value, QUIKCOPY then reads the first sector of the FAT and compares the media byte from the boot sector with the media byte from the FAT. Finally, QUIKCOPY checks the boot sector for the number of reserved sectors and the number of heads. Should any of the checks fail, QUIKCOPY declares that the disk is in a non-DOS format and will use the sector algorithm to copy the disk.

If the disk is indeed DOS formatted, QUIKCOPY employs the used-cluster algorithm to copy the disk (unless you specified /A on the command line). Of greatest importance when copying a DOS disk is the FAT, which QUIKCOPY uses to

determine which clusters are in use.

The FAT is an array of integers corresponding to the set of clusters on the disk; each value gives information about a cluster. Values from 2 to the highest cluster number on the disk are pointers to the next cluster in a file. Other values have special meanings (see Figure 6). If a disk contains more than 4,086 clusters, it uses a 16-bit FAT; otherwise, it uses a 12-bit FAT.

QUIKCOPY uses the information in the FAT to copy only allocated clusters to memory. QUIKCOPY can thus copy a disk that contains few files far faster than DISKCOPY and also requires less memory. Figure 7 contains the code used by QUIKCOPY to determine the amount of memory needed to copy the used clusters.

PHYSICAL DISK ADDRESSES Copying only used clusters is not as simple as it may first seem. When performing low-level I/O operations (writing clusters rather than files), a program must know the cylinder, head, and sector number on the track where clusters start. To complicate matters further, clusters may span heads and cylinders.

The translation of a cluster number to a cylinder, head, and sector number (or physical disk address) is a two-step process. First, convert the cluster number into a logical sector number. Then, convert the logical sector number into a physical disk address.

```

/* .....
 *
 * get_disk_type() -- get disk physical information
 *
 * This routine fills in the physical parameters to the drive info
 * block if the disk has been formatted with DOS.
 *
 * Returns:
 * This routine fills in the dos_valid flag in the drive_info block. The
 * drive_info block contains information essential to QUIKCOPY about the
 * geometry of the source and target disks. Included in this block is the
 * dos_valid flag which this routine sets to one of the following values:
 *
 * -1 = disk is unformatted
 * 0 = disk is not DOS formatted
 * 1 = disk is DOS formatted
 * ..... */

IDRV  *get_disk_type(int drive)          // drive number
{
    char  buf[512];                      // one sector buffer
    struct boot_rec b;                   // temp boot record
    IDRV  *d;                            // drive info block

    d = (IDRV *) huge_malloc(SS(drive_info)); // get memory for drive info
    clear_memory((HUGE *) d, SS(drive_info)); // ..and clear to nulls

    d->drive = drive;                    // set up bare necessities
    d->heads = 2;                        // default heads
    d->tracks = 40;                       // ..cylinders or tracks
    d->sectors = 9;                       // ..sectors per track
    d->bytes_sector = 512;                // ..temp sector size
    d->max_secs = 8;                     // ..max sectors per transfer
    d->dos_valid = 1;                    // assume valid DOS disk

    r.h.ah = 0;                         // ah = reset disk fnc
    r.h.dl = d->drive - 1;               // dl = drive number
    int06(0x13, &r, &r);                // reset disk system first

    if (disk_io(0, 0L, 1, (HUGE *) &b, d)) // q. read boot sector ok?
    {
        d->dos_valid = -1;               // a. no .. format the disk
        return(d);                      // ..show disk status
        // ..and return w/drive block
    }

    if (sw_all)                          // q. using /All switch?
    {
        if (NOT find_disk_maximuns(d)) // q. find maximums?
        {
            d->dos_valid = -1;           // a. no .. needs formatting
            printf("Format the disk!\n"); // ???
        }
    }

    else if (NOT check_media_byte(b.media, d)) // q. valid DOS disk?
    {
        d->dos_valid = 0;                // a. no ..
        // ..show disk status
    }

    else if (disk_io(0, b.res_sectors, // q. read 1st FAT sector ok?
        1, buf, d))
    {
        d->dos_valid = 0;                // a. no ..
        // ..show disk status
    }

    else if (buf[0] != b.media)          // q. same media descriptor?
    {
        d->dos_valid = 0;                // a. no ..
        // ..show disk status
    }

    else if (b.res_sectors != 1)         // q. right reserved sectors?
    {
        d->dos_valid = 0;                // a. no ..
        // ..show disk status
    }

    else if (b.heads < 1 || b.heads > 2) // q. right nbr of heads?
    {
        d->dos_valid = 0;                // a. no ..
        // ..show disk status
    }

    d->raw_disk = (long) d->heads * d->tracks // compute max disk size
    * d->sectors * d->bytes_sector;         // ..in bytes
    return(d);                            // then return w/disk info
}

```

Figure 5: QUIKCOPY determines whether a disk is DOS formatted by checking the value returned in the dos_valid field.

Special FAT Values

12-bit FAT	16-bit FAT	Meaning
0	0	Cluster not in use
0xFF0-0xFFB	0xFFFF0-0xFFFFB	Reserved cluster
0xFF7	0xFFFF7	Bad (unusable) cluster
0xFF8-0xFFFF	0xFFFF8-0xFFFFF	Last cluster in the file
All other values	All other values	Link to next cluster in file

Figure 6: Each FAT entry points to the next cluster in a file or indicates special conditions with a code.

QUIKCOPY reads the boot sector to determine the number of clusters per sector and how many sectors are used by the boot sector, the reserved sectors, the FAT or FATs, and the root directory. Having retrieved these values, a program can use the following function to translate a cluster number into a logical sector number:

```
logical_sector = ((cluster_number - 2)
* sectors_per_cluster)
- number_reserved_sectors
- (sectors_per_FAT * number_of_FATs)
- ((number_root_dir_entries * 32)
/ bytes_per_sector)
```

The values for sectors_per_cluster, number_reserved_sectors, sectors_per_FAT, number_of_FATs, number_root_dir_entries, and bytes_per_sector

are all contained in the boot sector. By DOS convention, 2 is the value for the first cluster on the disk. The value 32 is the length of a directory entry. Since the boot sector does not contain the number of sectors in the root directory, the number of sectors occupied by the root directory must be calculated. To do this, a program must determine the length of the root directory in bytes (multiply the number of entries by 32) and divide the result by the size of a sector.

Once a program has calculated a logical sector number, it is a small matter to convert that number to a physical disk address. But to do so, the program must know the number of sectors per track and the number of heads (or tracks) per cylinder. For DOS disks, QUIKCOPY asks DOS for the number of heads; for non-DOS disks, QUIKCOPY attempts to read from each head. With these numbers in hand, each component can be calculated as follows:

```
cylinder_number =
logical_sector /
```

```
(sectors_per_track *
number_of_heads)
head_number =
(logical_sector /
sectors_per_track)
MOD number_of_heads
sector_number =
(logical_sector MOD
sectors_per_track) + 1
```

To calculate the cylinder number, simply divide the logical sector number by the number of sectors per cylinder and throw away the remainder. First, however, since DOS does not return the number of sectors per cylinder, you must calculate it from the number of sectors per track and the number of heads.

To determine the head number, calculate the number of tracks that must be skipped to get to the track containing the sector, and then take the remainder when that value is divided by the number of heads on the drive. Although QUIKCOPY works only with floppy disk drives and all of today's floppy disk drives have two heads, QUIKCOPY supports duplication of single-sided disks and thus performs all the calculations for a variable number of heads. If we had chosen to ig-

```
/* .....
*
* get_mem_needed() -- determine EMS requirements for source DOS disk
*
* This routine calculates the EMS requirements by reading the file
* allocation table, counting allocated clusters and multiplying by
* the number of bytes per cluster. This routine also builds the
* copy_entry array which is a list of sectors to be copied.
*
* returns: nbr of bytes of EMS/XMS memory needed
* ..... */

long get_mem_needed(void)
{
    UINT i, // loop counter
          in_row, // in-a-row clusters
          max_row; // max copy in clusters
    char strings[3][10]; // temporary strings
    struct copy_entry huge *c; // work pointer

    d = get_disk_type(s_drv); // get drive information

    if (d->dos_valid != 1) // q. DOS disk?
    { // a. no ..
        sw_all = 1; // ..set proper switch
        return(get_all()); // ..then do it
    }

    get_fat(d); // get FAT from source disk

    i_remain = ((d->nclusters - // sectors needed
d->avail_clusters) * // ..to be moved
d->sec_cluster) + d->root_length; // ..and root directory

    printf(drive_info, s_drv + '\n', // give standard information
read_label(s_drv), d->nsectors, // ..about logical volume
d->nclusters, d->cluster_size, // ..and format out disk
large_fmt(d->raw_disk, // ..volume size
strings[0]),
large_fmt(d->raw_disk - // ..and total used
d->avail_disk,
strings[1]),
large_fmt(d->avail_disk, // ..and available size
```

```
strings[2]));

c_table = c = (struct copy_entry huge *) // allocate some memory
huge_malloc(((i_remain + 2) / // ..for starts
d->sec_cluster) * SS(copy_entry)); // ..then realloc later

c->c_sector = d->root_sector; // root directory sector nbr
c->c_length = d->root_size; // ..and root dir length
c++; // get to next copy entry

a_mem = coreleft() - 4096L; // start with almost everything
max_row = (int) (a_mem / d->cluster_size); // get max nbr of clusters
a_mem = max_row * d->cluster_size; // ..and final buffer size

if (NOT max_row) // q. at least one cluster buffer?
    quit_with(no_mem); // a. no .. quit with error msg

for(i = 2; i < d->nclusters; i++) // loop thru FAT
{
    if (cluster_status(i, d)) // q. allocated cluster?
    {
        c->c_sector = logical_sector(i, d); // a. yes .. save sector nbr

        for (in_row = 1, i++; // now find how many in a row
i < d->nclusters && // before the end of the FAT
in_row < max_row; // and before max transfer size
i++, in_row++)
        if (NOT cluster_status(i, d)) // q. next cluster used?
            break; // a. no .. exit loop

        c->c_length = in_row * // save length in bytes
d->cluster_size;
c++; // get to next copy entry
copy_entries++; // ..and keep a good count
    }
}

farrealloc(c_table, (long) copy_entries // readjust table length
* SS(copy_entry)); // ..for used amount

return(i_remain * d->bytes_sector); // return w/needed memory for
// ..clusters and the root dir
```

Figure 7: This code calculates the amount of memory needed to hold the used clusters and builds the list of sectors that must be copied.

nore this little-used format, we could have calculated the number as follows:

```
head_number =  
(logical_sector /  
sectors_per_track) AND 1
```

The final calculation is the sector offset within the track. In this case, the calculation simply returns the remainder after di-

viding the logical sector number by the number of sectors per track and adding 1. You must add 1 because the first sector on a track is sector 1, not sector 0.

START COPYING! You can learn much by exploring the techniques used to program QUIKCOPY. QUIKCOPY demonstrates how to gain low-level access to disk devices, format floppy disks, determine disk characteristics, and calculate

physical disk addresses. It's also a very useful utility—a worthy replacement for DISKCOPY and a sure end to the floppy-disk shuffle. □

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GUIDE TO OUR UTILITIES & HOW TO GET THEM

QUIKCOPY

PURPOSE: QUIKCOPY is a replacement for DOS's DISKCOPY command. Like DISKCOPY, which is found in DOS 6.2, QUIKCOPY can copy an entire disk in one pass, but it uses extended or expanded memory rather than a RAM disk. It can also speed the process by copying only used clusters.

SYNTAX: The syntax for QUIKCOPY is

```
QUIKCOPY source-drive [target-drive]  
[/1] [/A]
```

If the *target-drive* parameter is omitted, QUIKCOPY will assume that the source drive and the target drive are the same. The /1 parameter tells QUIKCOPY that you want to make only one copy of the source disk; you will not be prompted to change target disks after the first copy is completed. The /A parameter can be used to copy all of a disk regardless of whether a cluster is in use. This is the technique used by DOS's DISKCOPY command.

REMARKS: When QUIKCOPY reads the source disk, it examines the disk structure to determine if the disk is DOS or non-DOS. Then, based on its findings, QUIKCOPY uses one of two copy algorithms: a used-cluster algorithm, where only the portions of the disk marked by DOS as used are copied, or a sector algorithm, which copies all sectors regardless of what is stored there. If you choose, you can use the /A switch to force QUIKCOPY to use the sector algorithm.

As with the DOS DISKCOPY command, you are restricted to copying data between disks of like format—1.2MB to 1.2MB, 1.44MB to 1.44MB, and so on.

QUIKCOPY goes beyond DISKCOPY in its reporting. It shows a bar graph of progress as it copies the disk and also displays the source disk label and capacity, the amount of memory needed, the type of copy algorithm employed, and other related information. Upon completion, QUIKCOPY issues a final report showing number of disks written and data-transfer rates in bytes per second.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

■ HARDWARE

Better Graphics Performance

❓ I have a 486DX2/66 system with a Cirrus Logic CL-GD5426 graphics chip and 1MB of video RAM integrated into the motherboard. It's possible to disable the motherboard's graphics adapter circuitry, but the only expansion slots are 16-bit ISA: There are no VESA slots. Can I expect to get better performance from a top-of-the-line ISA card?

Kevin Li
Brooklyn, New York

► **PC MAGAZINE:** You'd see more improvement from a local-bus graphics adapter, but even an accelerated ISA graphics card should produce noticeable gains.

The Cirrus Logic CL-GD5426 chip is a fixed-function accelerator with limited functions. One of its appeals is that it is relatively inexpensive and does a good job on DOS applications. On the downside, its limited acceleration functions (BitBlts, image transfers, and raster operations) leave it trailing other accelerator designs when running Windows.

As a result, you could improve performance by picking an ISA card based on a more powerful accelerator. On the other hand, you might consider swapping your motherboard at the same time and getting one that supports VL-Bus cards. The extra cost may be minimal if you can move your CPU and memory over to the new motherboard.—*Alfred Poor*

Sticky Envelope Update

► **PC MAGAZINE:** In the issue of March 29, 1994, we published a tip about using a microwave to dry out envelopes. A number

of readers wrote to point out a risk involved in this procedure. A microwave oven needs to have a certain *load* (created by having sufficient water as a target for heating) to operate correctly; operating an empty microwave oven runs the risk of permanently damaging the oven's magnetron.

Many readers recommended simply using a conventional toaster oven to dry out envelopes, but there is a way you can do it in your microwave. Place a mug of cold water in a plastic bag (with most of the air removed to make room for the water vapor given off as the water heats up) and put this in your microwave along with your envelopes. You'll get dry envelopes along with a hot cup of water you can use to brew a relaxing cup of tea that you can drink while you print your envelopes.—*Alfred Poor*

■ OPERATING ENVIRONMENTS

Mystery Files

❓ Not surprisingly, typing DIR at the DOS prompt in the empty directory C:\TMP displays nothing but the . and .. entries. But typing ECHO. | DIR gives quite a different result. The "empty" directory contains two files with names like

AJAICAAG and AJAICAAM.

Why does ECHO. | DIR display these files? Every time I type the command, the filenames change. It seems random! And I can't seem to view the files either. What's going on?

Mário de Castro
New York, New York

► **PC MAGAZINE:** The upright bar symbol, |, seems to pipe the output of one program into the input of another. Actually, though, it stores the first program's output in a temporary file, and then when the first program terminates, it redirects that temporary file into the second program. The files you're seeing are (you guessed it) temporary pipe files.

The files are created in the directory named by the TEMP environment variable or in the current directory if the TEMP variable doesn't exist. You probably have your TEMP environment variable set to C:\TMP. The filenames are not random; rather, they are based on the current date and time, so files created a fraction of a second apart will still have different names. These temporary files disappear as soon as they're no longer needed. They're harmless and difficult to see. You happened to hit on the exact cir-

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cumstance that makes them visible!—Neil J. Rubenking

Staying on Top Revisited

❗I'm trying to adapt the FORM.TXT Microsoft Visual Basic program from "Staying on Top" (Solutions, February 8, 1994) to a button-bar utility I've created—so far without success. The problem is that I don't want the button bar to be inactive, and both of the examples that were given contain the constant SWP_NOACTIVATE. I'd like the utility to remain active, on top, and full-size unless closed.

The example provided by the reader did not indicate where to put the following code:

```
handle = form1.hwnd
HWND_TOPMOST = -1
wp = SetWindowPos(handle,
    HWND_TOPMOST, 0, 0, 0, 0,
    SWP_NOSIZE + SWP_NOMOVE +
    SWP_NOACTIVATE)
```

I've tried leaving out the SWP_NOACTIVATE constant to keep the utility active, to no avail. If there is another

API function call, or there are a few bits of code that would keep my utility on top and active, I'd appreciate learning about it.

Doug Richardson
Glendale, Arizona

►PC MAGAZINE: Quite a few readers misunderstood the function of SWP_NOACTIVATE. This constant by no means prevents the window in question from becoming active. It simply tells SetWindowPos() not to bother activating the window. You can freely omit this constant, with the result that the SetWindow-

Pos() function call will activate the window. And, of course, any time you click on the button-bar window, it will become the active window.

Windows can have just one active window at a time. Click with the mouse on an inactive window and that window becomes the active window. There is no Windows function to make a single window always the active window, because this would disable all other windows!

If your utility never needs to turn off the always-on-top feature, simply put the SetWindowPos() function call in the main form's Load method. As for keeping the utility full-size until it's closed, you can do that by adjusting the form's properties. Set MaxButton and MinButton to FALSE and BorderStyle to either Fixed Single or Fixed Double.

—Neil J. Rubenking

Running Just One Program Under Windows

❗Most of my software runs under DOS, but occasionally I use a Windows program. Is there any way to run a Windows program so that when I exit the application I return directly to DOS? I'd like to bypass the Windows desktop and avoid having to select File | Exit Windows and then answer the irritating confirmation dialog box.

Kevin N. Daniel
Bend, Oregon

❗Is there a simple way to change the Windows Shell= line at start-up? I've donated my old machine to my kids, who now play games on it. Most of the soft-

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PC SOLUTIONS

Operating Environments

ware they run is DOS based, but they have a few Windows applications. I've built a simple batch menu to help the kids navigate, but there's a problem when they're done with a Windows based game: Starting Windows with `WIN progname` leaves them in Windows (and confused) when they exit the game.

I've tried an unglamorous, batch file solution to build `SYSTEM.INI` with a `Shell=` line that runs the desired game. It works, but there must be a better way.

*Mark Tomlinson
Chicago, Illinois*

► **PC MAGAZINE:** To make Windows run a single program and shut down when that program finishes, put the program name on the `Shell=` line in the [boot] section of `SYSTEM.INI`. Try it: Before starting Windows, change that line from `Shell=PROGMAN.EXE` to `Shell=SOL.EXE`. Run Windows and Solitaire comes up. When you exit Solitaire, Windows shuts down.

Changing that line by hand every time would be a pain, though, and since `SYS-`

`TEM.INI` changes during the normal course of Windows operations, you can't "freeze" multiple copies of it with different `Shell=` lines. One solution lies in a small program called `INI.EXE`, which is available on PC MagNet. `INI.EXE` is a DOS-based program that modifies individual lines in `.INI` files. A batch file to make Windows run Solitaire and nothing else might look like this:

```
@ECHO OFF
REM WINSOL.BAT
INI system.ini boot shell sol.exe
WIN
INI system.ini boot shell
progman.exe
```

As an alternative, I wrote a tiny (under 2K) Borland Pascal program that simply executes the program whose name is contained in an environment variable called `SHELL`. Here's the entire program:

```
PROGRAM ShellR;
USES
```

```
WinTypes, WinProcs, WinDOS;
BEGIN
WinExec(GetEnvVar('SHELL'),
SW_SHOW);
END.
```

To use the program, put `SHELLR.EXE` in your Windows directory and change the `Shell=` line in the [boot] section of `SYSTEM.INI` to `Shell=SHELLR.EXE`. Before running Windows, set the environment variable `SHELL` to the name of the program you want to run—for example, `SET SHELL=SOL.EXE`. That's it! Set `SHELL=` to `PROGMAN.EXE` when you want to use Windows the usual way.

The one disadvantage of this technique is that it disables Program Manager's special start-up actions. Programs in the Startup group and on the `Load=` and `Run=` lines in `WIN.INI` will not get loaded nor will a program specified after `WIN` on the command line. Even the Windows Start and Exit sound events are disabled. If these limitations are acceptable, `SHELLR` provides an easy way to run sin-

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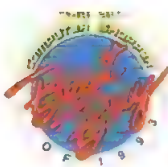
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gle programs under Windows. You can download both SHELLR.EXE and INI.EXE from PC MagNet's Utilities/Tips Forum.—Neil J. Rubenking

■ WORD PROCESSING

Auto-Miscorrection

One convenient feature of Microsoft Word for Windows, Version 6.0, is its ability to correct the common mistake of typing two initial capital letters instead of one. Hold down the Shift key a little too long when typing this sentence, for example, and you'll end up with HOld instead of Hold. Put a check in the Correct TWo INitial Capitals box under Tools|AutoCorrect, however, and WinWord will automatically fix your mistake.

Unfortunately, there seems to be no way to tell WinWord to leave the two initial caps alone for some words. With the AutoCorrect feature toggled on, for example, WinWord will "correct" PCs to Pcs, forcing you to go back and restore the uppercase C. If you use computer terms frequently, this can be more of a nuisance than doing without the AutoCorrect feature.

Short of writing a macro for each word for which you need to override the correction feature, is there a way to persuade WinWord to leave specific words alone so that you can still take advantage of the automatic correction?

Jamie McCollum
Rosemont, Pennsylvania

►PC MAGAZINE: The solution to this problem is surprisingly easy: It's actually part of the AutoCorrect function. It involves just enough of a twist, however, to make me uncertain as to whether Microsoft actually intended it as a solution for a recognized problem. The trick is not to tell WinWord to leave certain words alone; rather, it is to use the Replace Text as You Type feature to change the miscorrections back to what you want.

Since the Correct TWo INitial Capitals feature changes PCs to Pcs, you need only select Tools|AutoCorrect, enter Pcs in the Replace text box, enter PCs in the With text box, and then choose Add. (You might note that if the Replace Text as You Type check box isn't already checked, WinWord will check it when you

add a definition.) With both the Correct TWo INitial Caps and the Replace Text as You Type features active, the second feature will cancel the effects of the first when you type the word PCs. In fact, on a 486/66, at least, you won't even see a flicker of screen update to indicate that the capitalization is being changed and then changed back.

In preparing a list of words for the Replace Text as You Type feature, you should note that WinWord's AutoCorrect will leave the two initial caps alone if there is at least one more uppercase letter in the word. Thus, for example, PCs gets auto-corrected, but CPUs does not. Programmers encounter this situation fre-

Using array formulas in Microsoft Excel 5.0 can often simplify the task of performing complex calculations.

quently. Borland's OWL is full of names such as TEdit, TApplication, TWindow, TControl, and so on that get auto-corrected, while words such as TBufStream, TPrintDialog, and TGroupBox are left alone.—M. David Stone

■ SPREADSHEETS

Understanding Array Formulas

✓TIP Using array formulas in Microsoft Excel 5.0 can often simplify the task of performing complex calculations. For example, the formula in G3 of Figure 1 calculates the percentage of employees whose salaries are greater than or equal to the value of D3 and less than the value of F3. The formula reads as follows:

```
=SUM((($B$2:$B$23>=D3)*($B$2:$B$23<F3))/COUNT($B$2:$B$23)
```

The formula in H3 calculates the total number of dollars earned by these employees, as follows:

```
=SUM(($B$2:$B$23>=D3)*($B$2:$B$23<F3)*$B$2:$B$23)
```

To turn these formulas into array formulas, simply end them by pressing Ctrl-Shift-Enter instead of just Enter. Excel itself will enclose the formulas in braces, showing that they are arrays.

Because the references to B2:B23 are absolute, while those to D3 and F3 are relative, you can simply copy the formulas downward to get the percentages and dollar totals for each range of salaries in the employee table.

Calculating the same information without array formulas would have involved a great many additional formulas and produced a much more cluttered worksheet.

David C. Hager
Baton Rouge, Louisiana

►PC MAGAZINE: Excel's array formulas fall into two broad categories: First, there are single formulas that produce an array of result values. Second, there are formulas that perform calculations on an array of input values.

Formulas built with Excel's FREQUENCY() function exemplify the first type. FREQUENCY() creates a frequency-distribution table. You start by selecting the cells in which you want the table to appear. With this entire range selected, you then enter the formula in the selection's active cell. By pressing Shift-Ctrl-Enter at the end of the formula, you signal that you expect an array of results. Excel then obligingly fills the selected range with your frequency-distribution table.

Mr. Hager's array formulas are examples of the second type. These formulas compress a result that involves many intermediate calculations into a single output cell. In spreadsheet programs that lack array functionality, the result of each intermediate calculation would have to be stored in a separate cell, and an additional formula would be required to tally the results.

Mr. Hager's second formula (the one in H3) is a good starting point for understanding how this type of array formula works. Everything within the outer parentheses—that is, everything following the word SUM—is evaluated once for each element in the range B2:B23. It is this it-

erative process that makes the formula an array formula.

Inside the outer parentheses are three terms:

- (\$B\$2:\$B\$23>=D3)
- (\$B\$2:\$B\$23<F3)
- \$B\$2:\$B\$23

The first two of these terms are *logical* expressions, which evaluate either to true or to false. When the result of a logical expression is used in an arithmetic operation, Excel treats true as 1 and false as 0. As shown in Figure 1, at each iteration, each of the two expressions generates either a 1 or a 0. On the first iteration, the first expression compares B2 with D3, and the second expression compares B2 with F3. On the second iteration, the first expression compares B3 with D3, while the second compares B3 with F3, and so on.

The third term, \$B2:\$B\$23, is a simple range reference. At each iteration, this reference returns the value of one cell in the range. The first iteration returns the value of B2, the second returns the value of B3, and so on.

At each iteration, the three terms are multiplied by one another, and the product is fed to the SUM function, which sits outside the outer parentheses. The product of the first two expressions is 1 if both comparisons are true and 0 if either is false. If the product is 1, 1 is multiplied by the current value in B2:B23 (B2 on the first iteration, B3 on the second, and so on) so that the SUM function gets the value of the current cell in B2:B23. If the first product is 0, the SUM function gets 0. Thus, the formula

produces a sum of all salaries that lie between the values of D3 and F3. The iterative applications of the formula in column H work similarly, comparing the other values in the B2:B23 range with the other values in columns D and F.

The applications of the formula Mr. Hager uses in column G first generate a count of the salary values that fall within prescribed values. They do this by multiplying the results of two logical expressions ("Is it greater than or equal to D3?" times "Is it less than F3?") and then feeding the resulting 1s and 0s to the SUM function. This intermediate result is then divided by COUNT (\$B2:\$B\$23), which is simply the number of terms in the B2:B23 range. The end result is the fraction of salaries that fall within the test range. This fraction is formatted as a percentage with two decimal places.

Mr. Hager's letter correctly points out the advantages of using an array approach: The formulas are compact and elegant. The disadvantages are that the formulas are hard to figure out, and they must be terminated with Shift-Ctrl-Enter.

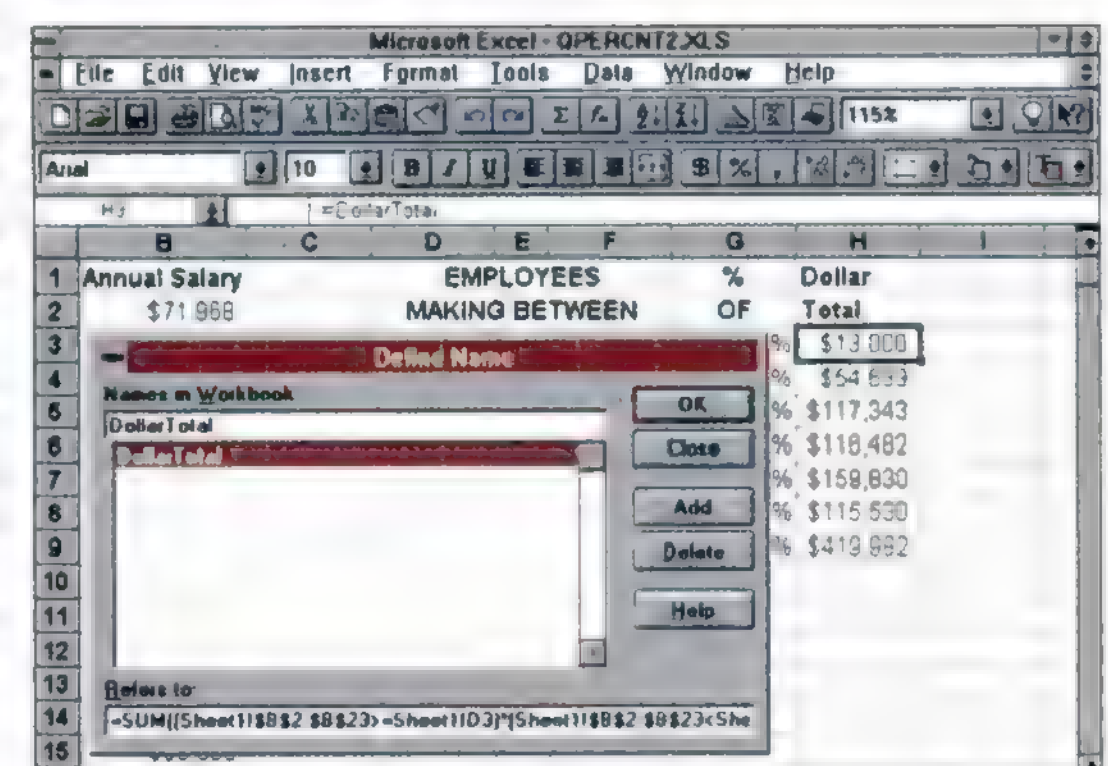


Figure 2: Using an off-sheet name as a proxy for an array formula relieves you of the need to press Ctrl-Shift-Enter. Note that Excel automatically adds sheet references to the Refers To line of the dialog box.

Microsoft Excel - QPERCENT2.XLS							
File Edit View Insert Format Tools Data Window Help							
[Toolbar icons]							
Name: G3 Formula: [=SUM((\$B\$2:\$B\$23>=D3)*(\$B\$2:\$B\$23<F3)/COUNT(\$B\$2:\$B\$23))]							
1	A	B	C	D	E	F	G
2	Employee	Annual Salary					
3	JJD	\$71,968					
4	BAJ	\$21,417					
5	WEF	\$30,726					
6	DDL	\$59,850					
7	CLH	\$28,827					
8	DFK	\$55,580					
9	XBC	\$18,015					
10	PBS	\$25,000					
11	MJS	\$88,208					
12	BCH	\$15,207					
13	JDP	\$71,817					
14	VLG	\$32,980					
15	GEM	\$89,145					
16	FFT	\$53,803					

Figure 1: The array formula in G3 calculates the percentage of employees whose salaries are greater than or equal to the value of D3 and less than the value of F3.

ate array formulas on worksheets for less experienced Excel hands, here's a tip worth knowing. Create an off-sheet name for each array formula, and then use the name, not the formula itself, on the worksheet. (An off-sheet name is a name that doesn't refer to a worksheet cell or a range.) Using a name as a proxy for an array formula relieves you (or your coworker) of the need to press Ctrl-Shift-Enter. (Note that this technique works only for array formulas of the second type—those that store all their results in a single cell. Array formulas that spread results across multiple cells must still be terminated with Shift-Ctrl-Enter.)

The latter problem is not trivial. If you forget to use that oddball keystroke combination, while either entering the formula or editing it, in most cases you will not get an error message or error value. Instead, you'll get a perfectly innocent looking but incorrect result.

If you like to use arrays but have trouble remembering to use Shift-Ctrl-Enter, or if you cre-

ate array formulas on worksheets for less experienced Excel hands, here's a tip worth knowing. Create an off-sheet name for each array formula, and then use the name, not the formula itself, on the worksheet. (An off-sheet name is a name that doesn't refer to a worksheet cell or a range.) Using a name as a proxy for an array formula relieves you (or your coworker) of the need to press Ctrl-Shift-Enter. (Note that this technique works only for array formulas of the second type—those that store all their results in a single cell. Array formulas that spread results across multiple cells must still be terminated with Shift-Ctrl-Enter.)

To apply this technique to the array formulas in H3:H9 of Mr. Hager's worksheet, you would do the following:

- Select H3. You must begin with this cell selected because your formula involves relative references. Excel will calculate those references as offsets from the current selection.
- Press Ctrl-F3 to get to the Define Name dialog box.
- On the top line of the dialog box, type a descriptive name for your formula—for example, DollarTotal.
- On the Refers To line, enter the formula

```
=SUM((($B$2:$B$23>=D3)*($B$2:$B$23<F3))/COUNT($B$2:$B$23))
```

- Click OK to close the dialog box.
- In H3, type =DollarTotal, and then press Enter.

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AD#G08

- Copy H3 to H4:H9.
- As an optional last step, attach a note to H3 indicating that DollarTotal is an off-sheet name defined as an array formula. Figure 2 shows the DollarTotal formulas alongside the Define Name dialog box. Notice in this figure that Excel has added sheet references to the Refers To line of the dialog box. The program will do this for you automatically: As long as all your references are to cells on the current sheet, you don't have to worry about the sheet references while you're defining the name.

Defining an array formula as an off-sheet name—using the name instead of the formula—keeps complex formulas off your formula bar, reducing the possibility of their being broken by an errant edit. It also relieves you or your user of the need to remember the magic keystroke combination that signifies an array.—*Craig Stinson*

■ GRAPHICS

Eliminating an Incorrect Error Message

❓ After deciding that I didn't need or want Adobe Type Manager on my system, I deleted it and threw the installation disk away. Now whenever Windows starts up, I get a message that says, "Cannot Load ATM32.DLL." I can't continue until I click the OK button in the dialog box, and I know that I deleted that particular file.

How can I get rid of the error message? Please make your explanation as simple as possible, since I'm nervous about making changes to my Windows setup.

*Mark O'Donnell
Alpharetta, Georgia*

► **PC MAGAZINE:** The Adobe Type Manager (ATM) program rasterizes PostScript Type 1 fonts on the fly in order to display them on your screen and print them on non-PostScript printers. The key words here are *on the fly*. In order to rasterize fonts as needed, ATM must reside in memory. To ensure that the program is always loaded, the ATM installation procedure makes changes to the SYSTEM.INI file, which is one of several different files used to configure Windows. Although you've deleted all the ATM files from your hard disk, your SYSTEM.INI file still contains references (in-

cluding loading instructions) to ATM.

You're absolutely right to be hesitant about making changes to SYSTEM.INI. If that file gets corrupted or accidentally deleted, Windows will not run properly, if at all. In this case, however, changing SYSTEM.INI manually is the only way to solve your problem. Don't proceed, though, until you make a backup copy of the SYSTEM.INI file, which you'll find in the Windows subdirectory, so you can immediately revert to the backup to restore Windows to its former state. Then, follow these rather simple steps:

- Open File Manager and double-click on the SYSTEM.INI file in the Windows directory. This will automatically load the Windows Notepad application and open the SYSTEM.INI file. Or you can run SYSEDIT.EXE from the Program Manager file menu. Sysedit automatically loads AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI, and it makes a backup of any files you change. If you edit SYSTEM.INI, your original, unedited SYSTEM.INI will be preserved as SYSTEM.SYD. You can actually use any word processing or editing program to make the necessary changes, provided that it reads and writes pure ASCII files: Any added formatting or control characters will corrupt the SYSTEM.INI file. By using the Windows Notepad or Sysedit, you are assured of saving the file as plain ASCII.
- The very first section of SYSTEM.INI should have the header [boot]. Locate and delete the following line:

```
atm.system.drv=system.drv
```

- Now locate the line that reads

```
system.drv=atmsys.drv
```

and change it to

```
system.drv=system.drv
```

- Save the modified SYSTEM.INI file and restart Windows. You should no longer see the ATM error message on

your screen.

If you want the luxury of removing programs from Windows without delving into the intricacies of the WIN.INI and SYSTEM.INI files, you should definitely purchase Uninstaller, Version 2.0, from MicroHelp (\$59.95, 404-516-0899). This amazingly useful utility tracks down all of the files related to an application you want to delete, erases them at your command, and even cleans up the SYSTEM.INI and WIN.INI files for you.

—*Luisa Simone*

■ LANGUAGES

Stop the Beeping

❗ **TIP** Here's a simple solution to an anomaly in Visual Basic's handling of text-box controls. Whenever you press Enter in a text box, the text is accepted correctly, but the program beeps. This is confusing for many users. The beep can be prevented simply by killing the Enter keystroke after it is recognized. The brief routine listed in Figure 3 shows how to do this.

*Jess Diard
Durham, North Carolina*

► **PC MAGAZINE:** The standard way to handle this common problem is to create a button that has the default focus, so when

VB Subroutine to Prevent Text-Box Beeps

```
Sub Text1_KeyPress (KeyAscii As Integer)
    If KeyAscii = 13 Then 'the Enter key
        KeyAscii = 0 'send it to the corn field
        'add your code here to process the text
    End If
End Sub
```

Figure 3: This Visual Basic routine will prevent the computer from beeping when a user presses the Enter key while in a text-box control.

the user presses Enter, the button is selected. But that method wastes screen space and, in my opinion, is equally confusing and clumsy for most users.

Another valuable use for this tip is that it can allow the Enter key to move the focus to the next field. Although Windows normally uses the Tab key to navigate from field to field on a data-entry form, many programmers also like their applications to recognize Enter for this purpose. You can achieve this by adding code that sets the focus to the next control in the Tab order whenever the Enter key is detected.—*Ethan Winer*

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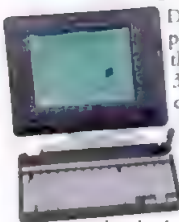
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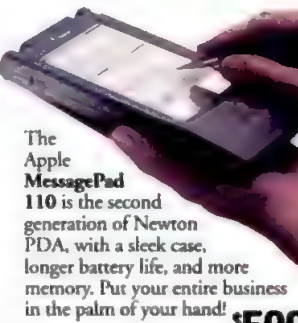
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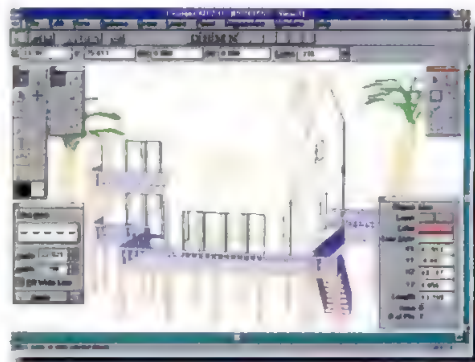
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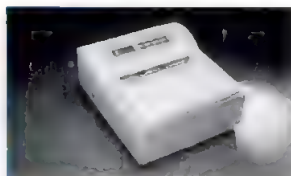
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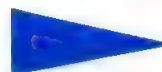
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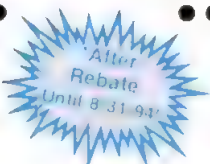


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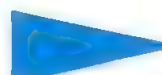
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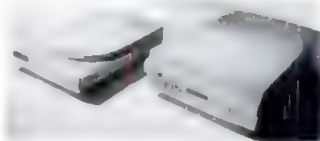


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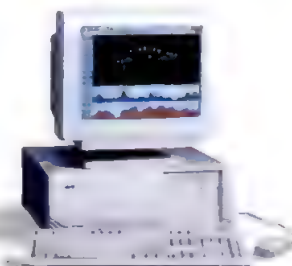
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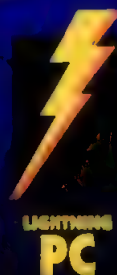
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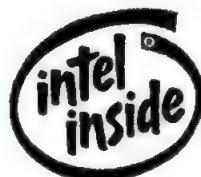
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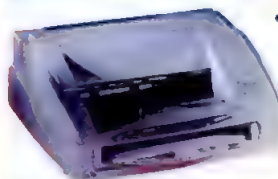
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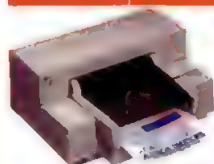
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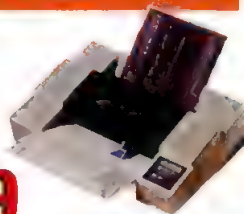
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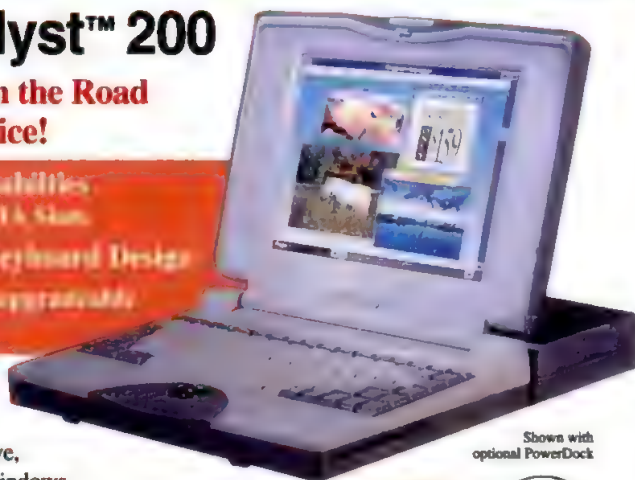
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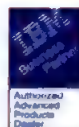
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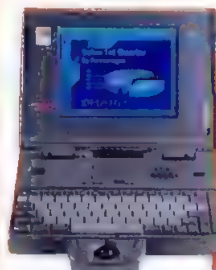


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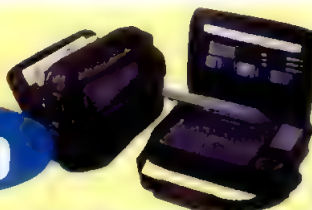
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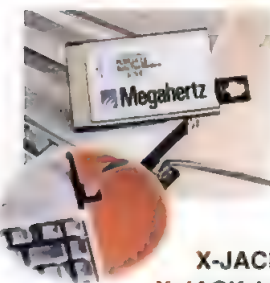
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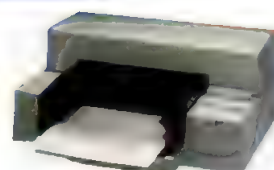
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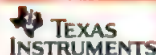


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LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB
LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB
LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB
LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB	LC 4/33S 11MB

NOTEBOOK 4-1/2" 20MB MONO	1592.15
NOTEBOOK 4-1/2" 20MB PASS COLOR	2267.73

CANON Notebooks

4/33 120MB mono	1899.98	4/33 200MB pas cr	2577.43
4/33 200MB mono	1989.75	4/33 130MB pas cr	2846.81
4/33 120MB pas cr	2477.93	4/33 260MB pas cr	2997.45
INNNOVA NB 4/33S 120MB mono	1543.86		
INNNOVA NB 4/33S 170MB mono	1613.78		
INNNOVA NB 4/33S 170MB pas col	2117.67		
INNNOVA NB 4/33S 260MB mono	1701.68		
INNNOVA NB 4/33S 260MB pas cr	2205.35		
INNNOVA 4/33S 170MB	1329.55		
INNNOVA 4/33S 170MB	1408.96		
INNNOVA 4/33S 170MB	1538.57		
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EPSON

ActionNote 45LCS/50 120MB-modem	1442.05
ActionNote 45LCS/50 180MB-modem	1493.04
ActionNote 500C 120MB-modem	1702.87
ActionNote 500C 180MB-modem	1963.08
ActionNote 700 120MB mono	1988.16
ActionNote 700C 120MB pas cr	2469.25
ActionNote 700C 210MB pas cr	2547.78
ActionNote 700C/210MB act cr	3197.84

IBM ThinkPad Portables

350 120MB mono	1499.00	350C 250MB pas cr	2199.00
350C 250MB mono	1899.00	350C 450MB pas cr	2699.00
350C 120MB pas cr	1799.00	350C 450MB/210MB	1699.00

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4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB
4/25SX 4/120MB	4/25MT 120MB	4/25MT 120MB	4/25MT 120MB

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4/50 200MB Color	4171.50		
READY 4/33S 210MB Multimedia	1438.86		
IMAGE III 4/50 210MB	1899.70		
IMAGE III 4/50 210MB	1807.48		
POWERMATE 4/33SX 170MB	1129.54		
POWERMATE 4/60DX2 210MB	1727.72		

PACKARD BELL

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Force 4/33SX 210MB	849.00
Force Multimedia 4/25X 340MB	1318.58
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Force 4/50SX2 340MB	1178.39
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TM4000M 4/25 120MB adv pas cr	
TM4000M 4/25 200MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	
TM4000M 4/75 340MB active cr	

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ML395	984.32	OL410E	649.31
ML395C	1014.74	OL810	801.50
ML520	169.42	OL830+	1079.11
ML521	495.18	OL850 PS	1199.20

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BJ200E*	254.00	LBP430 LASER*	558.50
BJ230	358.00	600DPI 6PPM	1268.57

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AP3260	177.75	DFX8000	2247.45
LK300	169.16	Stylus 300	194.54
FX870	267.59	Stylus 400	244.00
FX1170	352.95	Stylus 800	274.20
LQ370	217.97	Stylus Color	559.32
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LQ670	441.91	ActionLaser 1800	947.33
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IBM LEXMARK LASER PRINTERS

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4039-10 10PPM	1115.42
4039-10R 10PPM	1277.46
4039-10R 10PPM DUPLEX	1747.77
4039 18L PLUS	2657.44
4039 12L PLUS	1847.57
4039 12R PLUS	1937.57
WinWriter 600	1177.30

NEC

SuperScript 610	477.78
SilverWriter 840	734.60
SilverWriter 1097	1377.60

Panasonic

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1624	385.20	3123 NEW	249.00
2023	162.27	4410 LASER	547.15
2124	318.41	4430 LASER	696.91
2130 new	203.80	4440 LASER	1019.76
2135 color	new	246.71	

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MICROMARK COLOR INKJET	379.13
MICROWRITER BASIC	507.16
MICROWRITER PS23	677.22
MICROWRITER PS65	917.20
MICROLASER PRO 600 PS23	1355.20
MICROLASER PRO 600 PS65	1524.25
POWERSTRIPE UPD-ML600	274.68

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14.4 INT W/FAX	119.50	WorldPort 14.4 w/fax	238.09
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Refresh rate	70Hz	75Hz	75Hz	75Hz	75Hz	75Hz	75Hz
Digital controls	✓		✓	✓	✓	✓	
Accucolor™			✓		✓	✓	
OptiClear™						✓	✓
Anti-static coating		✓	✓	✓	✓	✓	
Dual Dynamic Beam Focusing					✓	✓	✓
XGA-2 support		✓	✓	✓	✓	✓	
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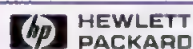
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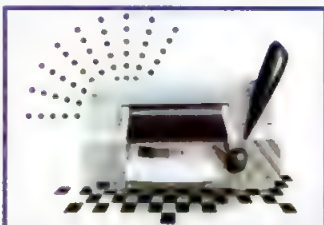


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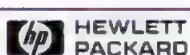
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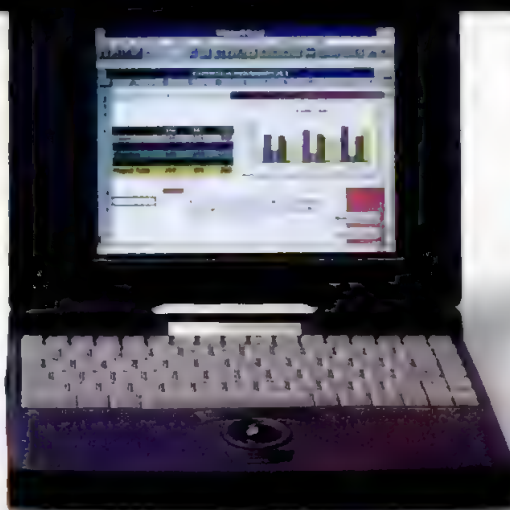
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HARD DISK	340MB	340MB	500MB
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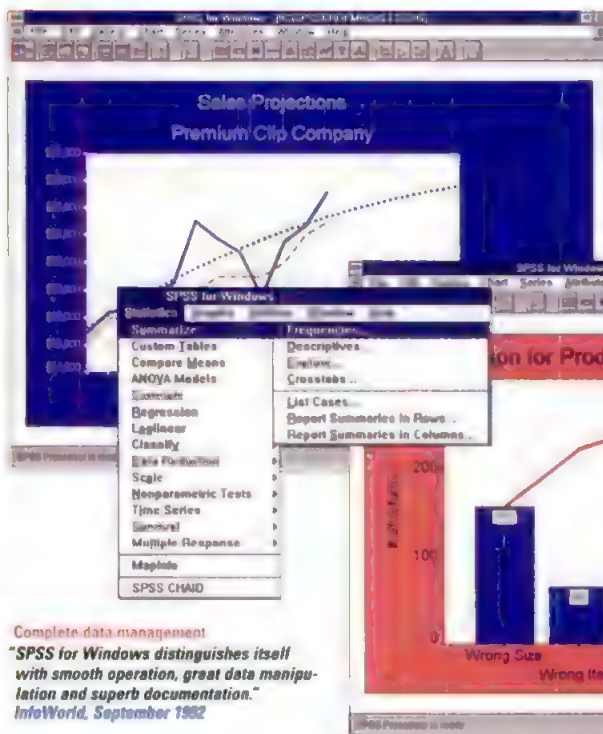
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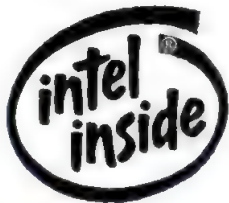
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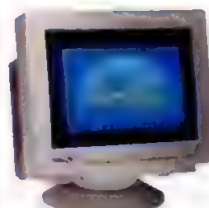
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CM2095MU \$1,349

SuperScan™ Elite 21"

1600 x 1200 N.I., dot .28, MPR II, 70 Hz

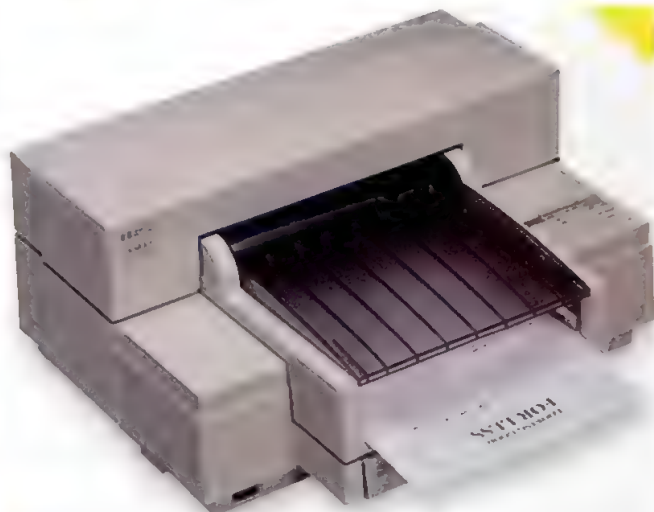
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HPDJ520

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DeskJet 560C HPDJ560C 539
LaserJet 4L HPLJ4L 649
LaserJet 4P HPLJ4P 985

VIDEO CARDS

Western Digital Paradise Accelerator Value Card

The Paradise Accelerator Value Card is a Super VGA Video Graphics Card that accelerates the performance of Windows and windowing programs and provides resolutions up to 1280 x 1024 in 16 colors, or up to 65,536 colors for 800x600 resolution. Opening, closing, scrolling and resizing of windows is faster because the Paradise Accelerator Value Card features built-in acceleration.

- 1MB SVGA 72MHz refresh rate
- Video controller
- Supports up to 1280 x 1024 resolution
- Supports up to 65,536 colors

Paradise Accelerator Value Card
VCXLR8VAL

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Local Bus Windows Accelerator Supports
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16.8 million colors, 1MB. Over 50 times
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Windows Accelerator
VCXLRPRO14 \$239
24 Bit Color Accelerator
VCXLR24BIT 109

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big business look
a lot smarter.



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TI microMarc

TEX1023 \$279
Color TEX1023C 379



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Nokia 447M 17" CM447B 1,199
Nokia 44BS 14" CM44BS 499



21" Vision Master .28 dot pitch
CMID6221 \$1,899
21" Vision Master .26 dot pitch
CMID8421 1,945



MultiSync 4FG 15", N.I., dot .28
CMNEC4FG \$629
MultiSync 5FG 17", N.I., dot .28
CMNEC5FG 1,079
MultiSync 5FGP 17", N.I., dot .28
CMNEC5FGP 1,349



15" Nanao 3401W Monitor,
1024 x 1024 N.I., dot .28, MPR
II, Energy Star.
CM3401W \$699

17" Nanao 5501W Monitor,
1280 x 1024 N.I., dot .28, MPR
II, Energy Star.
CM5501W 1,179

21" Nanao 7601W Monitor,
1280 x 1024 N.I., dot .31, MPR
II, Energy Star.
CM7601W 2,215



2380 \$319
2381+ 449
2390+ 329
2391 449
4079 Color 2,785
403916L 3,029



P3200 24 Pin
NCMDL3200 \$229
P6200 24 Pin
NCMDL6200 424
Silentwriter 1097
NCMDL1097 1,429



Action Printer 3260

- 24 Pin printer
- 50 Sheet paper tray
- Option color kit available

EPSAP3260

Epson Stylus 1000 \$445
Epson Stylus 800 285
Epson LX 300 169
Epson FX-870 275
Epson LQ-570+ 239
Epson LQ-1070+ 359



\$199

Epson LQ-870 \$439
Epson LQ-1170 625
Epson LQ-2550 Color 915
Epson DFX-5000+ 2,205



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KX-P4430 Laser 689
KX-P4440 Laser 1,059
KX-P2023 Dot Matrix 195
KX-P2124 Dot Matrix 315
KX-P3123 Dot Matrix 249
KX-P3624 Dot Matrix 409



BJ-10SX CNBJ10SXW \$249
BJ-230 CNBJ230 399
BJ-200E CNBJ200E 289
BJC-600 CNBJC600 589
BJC-K20 CNBJC820 1,499
LBP430 CNLBP430 589
LBP660 CNLBP660 1,389



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CM1780LR 699
20", 1280x1024 N.I.
CM2095MUO 1,249



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Capacity*	Access	Form Fac./Hgt.	Brand	Interface	Model	Bare Kit
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170MB	14ms	3.5" 1"H	Quantum	IDE	QULPS170A/S.....	199
170MB	12ms	2.5"	Western Digital	IDE/SCSI	WDAL2170.....	299
200MB	12ms	2.5"	Western Digital	IDE	WDAL2200.....	319
210MB	12ms	3.5" 1"H	Western Digital	IDE	WD1210A.....	199
210MB	14ms	3.5" 1"H	Seagate	IDE	ST3243A.....	199
213MB	14ms	3.5" 1"H	Conner	IDE	CFS210A.....	219
250MB	12ms	3.5" 1"H	Western Digital	IDE	WD2250A.....	219
260MB	12ms	3.5" 1"H	Seagate	IDE	ST3290A.....	209
270MB	12ms	3.5" 1"H	Quantum	IDE	QULPS270A/S.....	239/269
270MB	12ms	3.5" 1"H	Western Digital	IDE/SCSI	WD1270A.....	229
290MB	15ms	3.5" 1"H	Maxtor	SCSI	MX7290S.....	269/289
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD2340A.....	229
340MB	15ms	3.5" 1"H	Maxtor	IDE/SCSI	MX7345A/S.....	289/309
340MB	13ms	3.5" 1"H	Conner	IDE/SCSI	CFA340A/S.....	309/329
340MB	12ms	3.5" 1"H	Seagate	SCSI	ST3390N.....	379
340MB	12ms	3.5" 1"H	Quantum	IDE/SCSI	QULPS340A/S.....	279/299
340MB	13ms	3.5" 1"H	Seagate	IDE	ST3391A.....	249

420MB to 730MB

420MB	12ms	3.5" 1"H	Western Digital	IDE	WD2420A.....	279
420MB	14ms	3.5" 1"H	Seagate	IDE	ST3491A.....	279
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST3550A/N.....	299/409
426MB	14ms	3.5" 1"H	Conner	IDE	CFS420A.....	289
540MB	12ms	3.5" 1"H	Western Digital	IDE	WD2540A.....	349
540MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST3655A/N.....	369/409
540MB	10ms	3.5" 1"H	Conner	SCSI	CFA540S.....	679
540MB	12ms	3.5" 1"H	Quantum	IDE/SCSI	QULPS540A/S.....	389/399
545MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST5660A/N.....	379/419
545MB	12ms	3.5" 1"H	Maxtor	IDE	MX7546A.....	379
730MB	12ms	3.5" 1"H	Western Digital	IDE	WD2700A.....	469

976MB to 1.8 GIG

976MB	10ms	3.5" HH	Micropolis	SCSI	MC2210AV.....	829
1050MB	8.5ms	3.5" 1" H	Micropolis	SCSI	MC4110S.....	739
1050MB	9.5ms	3.5" 1"H	Seagate	SCSI	ST31200N.....	739
1080MB	9.5ms	3.5" 1"H	Conner	SCSI	CFP1060S.....	749/799
1080MB	10ms	3.5" 1"H	Fujitsu	SCSI	FJ2694S.....	699
1080MB	9ms	3.5" 1"H	Quantum	SCSI	QUEM1080S.....	739
1080MB	10ms	3.5" HH	Western Digital	IDE	WD31000A.....	679
1225MB	10ms	3.5" HH	Quantum	SCSI	QUPD1225S.....	949
1626MB	10ms	3.5" HH	Micropolis	IDE/SCSI	MC2217A/AV.....	969/1,039
1700MB	8ms	3.5" HH	Seagate	SCSI	ST11900N.....	1,099
1700MB	9ms	3.5" HH	Seagate	SCSI	ST11950N - Barracuda.....	1,499
1750MB	10ms	3.5" HH	Micropolis	SCSI	MC2217S.....	969
1800MB	10ms	3.5" HH	Quantum	SCSI	QUPD1800S.....	939

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2100MB	9.5ms	3.5" HH	Quantum	SCSI	QUEM2100S.....	1,449
2100MB	11ms	5.25" FH	Micropolis	SCSI	MC1926.....	1,399
2100MB	10.5ms	3.5" HH	Seagate	SCSI	ST12400N.....	1,449
2100MB	8ms	3.5" HH	Seagate	SCSI	ST12550N - Barracuda.....	1,639
2900MB	11ms	5.25" FH	Seagate	SCSI	ST43400N.....	1,999
3000MB	11.5ms	5.25" FH	Micropolis	SCSI	MC1936.....	1,999
3000MB	10ms	5.25" FH	Micropolis	SCSI	MC1936AV.....	2,149
4294MB	8ms	3.5" HH	Seagate	SCSI	ST15150N.....	2,399
9080MB	11ms	5.25" FH	Seagate	SCSI	ST410800N.....	3,995
9100MB	10ms	5.25" FH	Micropolis	SCSI	MC1991.....	4,059

*Capacities based upon manufacturer's quoted capacity where 1MB=1,048,576 bytes.

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\$999 ODFJ2512AK

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- Data Cable
- Jumper Blocks
- Rail Set
- Bezels

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FOR 16 BIT (286/386/486) KITS ADD:

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250MB Colorado Tape Backup and 2 250MB tapes.

WD2420TBK.....



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1000MB of Storage

1000MB Hard Drive plus 1000MB Tape Storage

MICROPOLIS

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PLUS

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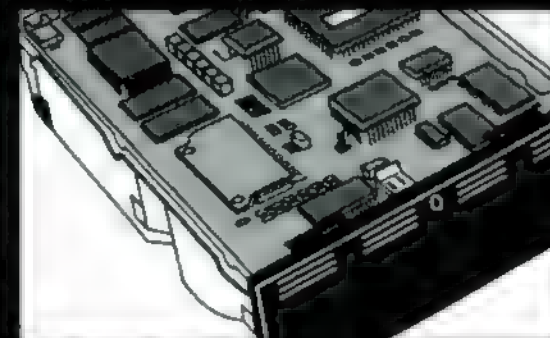
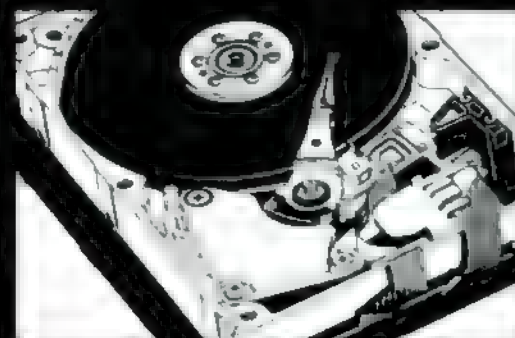
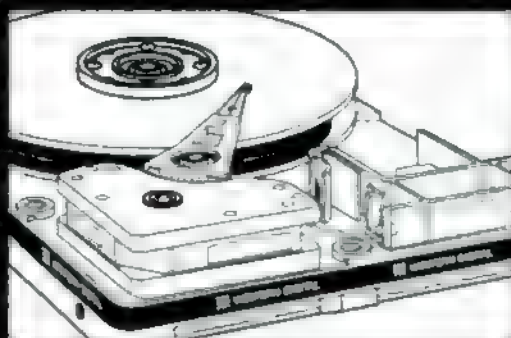


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420MB	14ms	CFS420A	\$269
541MB	12ms	CFA540A	\$369
1080MB	9ms	CFP1080A	\$669

SCSI			
1060MB	9ms	CFP1060S	\$699

Maxtor

IDE			
345MB	14ms	7345A	\$259
540MB	12ms	7546A	\$339

MICROPOLIS

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1740MB	10ms	MC2217A	\$919
SCSI			
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1740MB	10ms	MC2217	\$919
3020MB	11ms	MC1936	\$1969
SCSI-AV Audio / Visual tuned drives			
1000MB	10ms	MC2210AV	\$795
1700MB	10ms	MC2217AV	\$999
3000MB	11ms	MC1936AV	\$2119

Seagate

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341MB	13ms	ST3391A	\$259
540MB	12ms	ST3655A	\$365
SCSI (WIDE SCSI also available)			
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2145MB	8ms	ST12550N	\$1625
2148MB	9ms	ST12400N	\$1229

WESTERN DIGITAL

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341MB	12ms	AC2340	\$239
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540MB	11ms	AC2540	\$359
730MB	10ms	AC2700	\$525
1083MB	10ms	AC31000	\$739

HARD DRIVES

Quantum

IDE			
210MB	14ms	LPS210A	\$199
270MB	12ms	LPS270A	\$229
342MB	12ms	LPS340A	\$269
541MB	12ms	LPS540A	\$339

SCSI			
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270MB	12ms	LPS270S	\$245
342MB	12ms	LPS340S	\$272
541MB	12ms	LPS540S	\$359
1080MB	10ms	IMP1080	\$679
1440MB	9.5ms	IMP1440S	\$899
2160MB	9.5ms	IMP2160S	\$1219

digital

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35 & 40	\$269	\$369	\$469
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A1522BASIC 16Bit SCSI	\$119	\$109
A1542CBASIC 16Bit SCSI	\$225	\$215
A2742 EISA SCSI	\$319	\$309
A2842 VESA SCSI	\$279	\$269
FUTURE DOMAIN		
1680SVP 16Bit SCSI	\$155	\$139
QLOGIC		
VESA SCSI	\$225	\$209
PCI SCSI-2 and WIDE SCSI	\$325	\$309
ALPHA RESEARCH CACHING CARDS		
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S47SI 32Bit Local Bus IDE	\$139	\$129
S48SI 32Bit PCI IDE	\$229	\$219
S42SS 16Bit SCSI	\$229	\$219
S47SS 32Bit Local Bus SCSI	\$369	\$359

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NEC	CDR510	3X	195ms	\$389
Toshiba	XM3401	2X	200ms	\$315
Toshiba	XM4101	2X	320ms	\$219
Sony	CDU561	2X	295ms	\$289
Teac	CD50	2X	265ms	\$259
Pioneer External CD Changers (300ms)				
DRM602X	6 disc	307KB/sec		\$869
DRM604X	6 disc	612KB/sec		\$1149
DRM1804X	18 disc	612KB/sec		\$2059

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MV=Media Vision Pro Audio 16. MS=Media Vision Pro Studio 16
SB=Sound Blaster 16 SCSI. SA=Sound Blaster SCSI ASP.

	MV	MS	SB	SA
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CD50	\$399	\$429	\$449	\$489
CDU561	\$429	\$459	\$469	\$519
XM3401	\$435	\$455	\$505	\$535
CDR510	\$509	\$539	\$579	\$609
CDR900	\$1119	\$1149	\$1159	\$1199

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CD ROM Drive Towers - Multiple CD ROM drives in a single external enclosure. Great for networks, BBS, or business.

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CD50	\$649	\$1389	\$2479
CDU561	\$699	\$1479	\$2639
XM3401	\$789	\$1659	\$2999
CDR510	\$939	\$1999	\$3499
CDR900	\$2119	\$4339	\$7489

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2Gig Conner 4320	\$799	\$969
2Gig HP 35470	\$929	\$1049
4-8Gig Conner 4324	\$1119	\$1329
4-8Gig HP 35480	\$1059	\$1279
4-16Gig Sony SDT5000	\$1099	\$1299
4-16Gig HP C1533A	\$1499	\$1699

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TravelMate 4000E Color

Processor	Screen	Hard drive	Price
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486DX/240	Enhanced Color	200MB	\$2069
486DX/250	Dual Scan	200MB	\$2319
486DX/250	Active Matrix	200MB	\$2819
486DX/475	8.4" Active Matrix	340MB	\$3549
486DX/475	8.4" Active Matrix	455MB	\$3899
486DX/475	9.5" Active Matrix	455MB	\$4489

Lease for \$67/mo.



TravelMate 4000M

- ▲ Brilliant color display
- ▲ 16-bit sound
- ▲ Integrated local bus graphics
- ▲ PCMCIA Type III slot

Processor/Display	Hard Drive	Price
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486SX/25 Active color	200MB	\$3179
486DX/475 Active color	340MB	\$4939

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- ▲ Double-speed CD-ROM drive
- ▲ 250ms access time
- ▲ Built-in speakers
- ▲ SCSI II connector

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TravelMate Intelligent Docking System

- ▲ 6 16-bit ISA slots
- ▲ 2 PCMCIA Type III slots
- ▲ 2 3.5" and 2 5.25" drive bays
- ▲ Auto Load/Eject feature

\$799⁹⁹

Hewlett Packard Power

LaserJet 4L

- ▲ 4PPM
- ▲ Crisp, 300dpi print-quality
- ▲ Resolution Enhancement Technology
- ▲ 1-year warranty

LaserJet 4L \$659.99

LaserJet 4P

- ▲ 4PPM
- ▲ Sharp, 600dpi print-quality
- ▲ 2MB RAM w/Memory Enhancement Technology
- ▲ 1-year warranty

LaserJet 4P \$959.99

LaserJet 4ML

- ▲ 4PPM
- ▲ Enhanced 300dpi resolution
- ▲ Plug-and-play Macintosh and Windows compatible
- ▲ 1-year warranty

LaserJet 4ML \$1019.99

LaserJet 4MP

- ▲ 4PPM
- ▲ True 600dpi resolution
- ▲ Auto switching between Macintosh and PC environments
- ▲ 1-year warranty

LaserJet 4MP \$1379.99



LaserJet 4L

DeskJet/DeskWriter 310

- ▲ High quality 3 PPM printing
- ▲ Low cost optional color kit
- ▲ 1-Year warranty

DeskJet 310 \$299.99
DeskWriter 310 \$299.99



DeskJet 310

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DeskJet 500C

- ▲ Letter-quality 300dpi color printing
- ▲ 100 Sheet feeder for versatile paper handling
- ▲ 3-year warranty

DeskJet 500C \$389.99

DeskJet/DeskWriter 520

- ▲ Sharp, 600x 300 dpi "laser-like" print quality
- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ 3-year warranty

DeskJet 520 \$289.99
DeskWriter 520 \$289.99

DeskJet/DeskWriter 560C

- ▲ Color 600x 300 dpi "laser-like" print quality
- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ 3-Year warranty

DeskJet 560C \$569.99
DeskWriter 560C \$569.99



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PACKARD**

Authorized Dealer

Toshiba Direct

T3400

T4700 and T4800

- ▲ 8MB RAM, expandable to 24MB
- ▲ Brilliant 9.5" display with local bus video
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows 3.1 (T4700)/ Windows for Workgroups 3.11 (T4800)

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	Dual scan color	200MB	\$3129*
T4700	486DX2/50	Dual scan color	320MB	\$3379
T4700	486DX2/50	Active color	200MB	\$4549
T4700	486DX2/50	Active color	320MB	\$4899
T4800	486DX4/75	Active color	500MB	\$5599

Lease for \$114/mo.

Portege T3400

- ▲ Ultra-portability at only 4.1lbs
- ▲ 486SX/33 processor
- ▲ 120MB hard drive
- ▲ 4MB RAM, expandable to 20MB
- ▲ PCMCIA Type II slot
- ▲ External 3.5" disk drive
- ▲ Integrated AccuPoint pointing device

Screen
Monochrome
Active Color

Price
\$1699
\$3419*

Lease for \$62/mo.

\$3419*

T4700



\$3129*

T1910 and T1950 Satellite Series

- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ Type III PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse with Quickport
- Enhanced power management

Model	Processor	Screen	Hard Drive	Price
T1910	486SX/33	Monochrome	200MB	\$1499
T1910	486SX/33	Dual scan color	200MB	\$2039*
T1950	486DX2/40	Dual scan color	200MB	\$2289
T1950	486DX2/40	Active color	200MB	\$2929
T1950	486DX2/40	Active color	320MB	\$3199

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\$2039*

T1950

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T1950
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TOSHIBA

NEC: Versatility

UltraLite Versa E

- ▲ 486 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball

Processor	Screen	Hard drive	Price
DX2/40	Active color	120MB	\$3819
DX2/40	Active color	250MB	\$4229
DX2/50	Monochrome	209MB	\$3259*
DX2/50	Active color	209MB	\$4499
DX2/50	Active color	340MB	\$4919
DX4/75	Active color	340MB	\$5229

Lease for \$120/mo.

MultiSync Monitors

3V

- ▲ 15" SVGA
- ▲ 1024x768, .28mm NI
- ▲ 72MHz VESA refresh
- ▲ MPR II, EnergyStar

\$469.99

2V-14" SVGA ~~\$339.99~~

UltraLite Versa E

The Versa E notebook series is upgradable to grow with your needs. For ease of upgrade and service, the UltraLite Versa's floppy drive, hard disk drive and memory card slide in and out of their storage slots. If you require extended battery life, slide out the Versa's floppy drive, pop in a second battery, and double your time on the road.



\$3259*

NEC MultiSpin 3X CD-ROM Drives

MultiSpin 3Xp Portable Drive	\$389.99
MultiSpin 3Xi Internal Drive	\$429.99
MultiSpin 3Xe External Drive	\$469.99
MultiSpin 4XPro External Drive	\$929.99



MultiSpin 3Xp Portable

UltraLite Versa S

- ▲ 486 processor
- ▲ 2 Type II PCMCIA slots
- ▲ 9.5" screen
- ▲ Only 4.2lbs. (mono)

Processor	Screen	Hard drive	Price
486SX/33	Mono	210MB	\$1889*
486SX/33	Dual scan	210MB	\$2319
486SX/33	Active color	210MB	\$3219
486DX2/50	Active color	260MB	\$3689

Lease for \$69/mo.

NEC

Compaq Compleat

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New LTE Elite

Concerto

- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" mono display
- ▲ 2 TYPE II or 1 Type III PCMCIA slots
- ▲ Untethered intelligent pen
- ▲ MS-DOS 6.0, Windows 3.1, InkWare NoteTaker,
- ▲ PenPower for Excel

Processor	RAM	Hard Drive	Price
486SL/25	4MB	120MB	\$1229
486SL/25	4MB	250MB	\$1319
486SL/33	4MB	250MB	\$1399

Lease for \$50/mo.

Contura Aero

- ▲ Type II PCMCIA slot
- ▲ Integrated trackball
- ▲ Weighs only 3.5 lbs. (mono), 4.31 lbs. (color)
- ▲ MS-DOS, Windows 3.1

Processor	Display	Hard Drive	Price
486SX25	Mono	87MB	\$999
486SX25	Mono	170MB	\$1419
486SX33	Passive Color	170MB	\$1989
486SX33	Passive Color	250MB	\$2269

Lease for \$50/mo.

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Computers Come with
a 3-year Warranty



**Contura Aero
\$999***

LTE Lite Models Available

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Contura 4/25

- ▲ 486SL/25 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 209MB hard drive
- ▲ Available with monochrome, dual scan or active matrix color display
- ▲ MS-DOS 6.0, Windows 3.1, trackball

Screen	Price
Monochrome	\$1989
Dual scan color	\$2319
Active matrix color	\$2839

Lease for \$73/mo.

ProLinea Desktops

- ▲ 4MB RAM expandable to 100MB
- ▲ 3.5" floppy drive
- ▲ Local bus graphics
- ▲ Pentium upgradable
- ▲ Energy Star compliant
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	200MB	\$1099*
486SX2/50	4MB	200MB	\$1249
486DX2/50	4MB	340MB	\$1599
486DX2/66	4MB	340MB	\$1829
486DX2/66	4MB	525MB	\$1969
486DX4/100	8MB	340MB	\$2299
486DX4/100	8MB	525MB	\$2469

*Compaq color monitors start at \$299.99

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- ▲ User upgradable processor, memory, hard drive, display and more
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- ▲ Choice of 10.4" monochrome, 10.3" dual scan color or 9.5" active matrix color display
- ▲ 32-bit VL local bus video
- ▲ Detachable video display
- ▲ Built-in 16-bit stereo sound with speaker and microphone
- ▲ Integrated trackball
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ MS-DOS, Windows for Workgroups, Microsoft Sound System
- ▲ 3-year warranty

Processor	Screen	Hard Drive	Price
486SX/33	10.4" monochrome	200MB	\$2449
486DX2/50	10.3" dual scan	200MB	\$3649*
486DX2/50	9.5" active matrix	340MB	\$4719
486DX2/50	9.5" active matrix	450MB	\$5069
Intel DX4/75	9.5" active matrix	520MB	\$5339



Z-NOTEFLEX Accessories

FLEXDOCK port replicator	\$219.99
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PCMCIA upgrade for FLEXDOCK	\$129.99
FLEXBAY floppy bay/battery recharger	\$159.99
FLEXSHOW multimedia companion	\$799.99
FLEXSITE LCD display stand	\$199.99



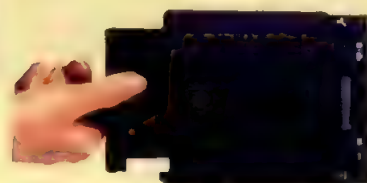
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Extend your viewing options up to 3 feet on your desk.



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Optional PCMCIA and Ethernet connectors available.



FLEXBAY

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- ▲ IBM DOS 6.3, MS Windows 3.11
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- ▲ VESA Local Bus graphics
- ▲ 512KB Video RAM exp. to 1MB
- ▲ 3 expansion slots, 3 drive bays
- ▲ IBM DOS 6.1/MS Windows 3.1, mouse, enhanced 101 keyboard

Processor	Hard Drive
486SX/25	120MB
486DX/33	212MB
486DX2/66	212MB

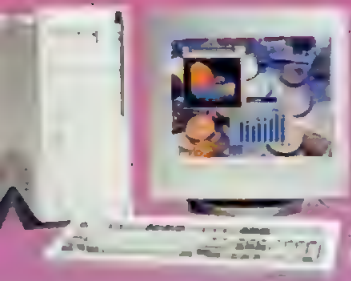
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- ▲ 16MB RAM exp. to 128MB
- ▲ 256KB cache standard
- ▲ 4 expansion slots (2 PCI, 1PCI/AT, 1 AT)
- ▲ 5 drive bays

Processor	Hard Drive
Pentium 60MHz	424MB
Pentium 60MHz	525MB

*monitor priced separately



ValuePoint Performance MiniTower



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- ▲ VESA local bus graphics
- ▲ 1MB video RAM
- ▲ MS-DOS 6.2, Windows 3.1
- ▲ Energy Star Compliant

Model	RAM	Hard Drive	Price
4/33s Model 173W	4MB	170MB	\$1099
4/33s Model 273W	8MB	270MB	\$1369
4/50s Model 173W	4MB	170MB	\$1249
4/50s Model 273W	8MB	270MB	\$1539
4/66d Model 273W	8MB	270MB	\$1889
4/66d Model 543W	8MB	540MB	\$2269
4/100t Model 273W	8MB	270MB	\$2299
4/100t Model 543W	8MB	540MB	\$2599

Lease for \$50/mo.



Bravo NB

- ▲ 466SX/33 processor
- ▲ Accelerated local bus graphics
- ▲ PCMCIA Type III slot

Model	Screen	Hard Drive	Price
4/33s 203W	Mono	200MB	\$1629
4/33s 203W	Dual Scan	200MB	\$2249

Lease for \$83/mo.

Bravo MT

- ▲ 2/4/8MB RAM exp. to 64MB
- ▲ Optional/170/340MB hard drive
- ▲ 32-bit accelerated local bus graphics

Model	Hard Drive	Price
4/66d Model 3	Optional	\$1539
4/66d/Model 173W	170MB	\$1799
4/66d Model 343W	340MB	\$2279

Lease for \$83/mo.

AST

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Ascentia 900N

- ▲ 486DX2/50 or 486DX4/75 processor
- ▲ 4MB/8MB RAM exp. to 32MB
- ▲ Dual scan or active color displays
- ▲ PCMCIA type III slot

Model	Screen	Hard Drive	Price
4/50 Model 253W	9.5" Dual Scan	250MB	\$2979
4/50 Model 343W	10.3" Dual Scan	340MB	\$3329
4/50 Model 343W	9.5" Active	340MB	\$4869
4/75 Model 343W	9.5" Dual Scan	340MB	\$3969
4/75 Model 513W	10.4" Active	510MB	\$5799

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ThinkPad 360 notebooks

- ▲ 486SL/33 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ Modular design, removable hard drive & floppy drive
- ▲ Local Bus Graphics with 1MB video RAM
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0
- ▲ Port Replicator and Docking Station available

Screen	Hard Drive
Monochrome	170MB
Monochrome	340MB
Dual Scan Color	170MB
Dual Scan Color	340MB
Active Color	170MB
Active Color	340MB

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ThinkPad 500 subnotebook

- ▲ IBM 486SLC2/50 processor
- ▲ 4MB RAM exp. to 12MB
- ▲ 170MB hard drive
- ▲ 7.4" VGA monochrome display
- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ NiMH battery, AC adapter
- ▲ Weighs only 3.8 lbs. (w/battery)
- ▲ IBM DOS 6.1, Prodigy



ThinkPad 360



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14.4/14.4
MODEM
\$229.99

Model	Description	Price
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CC4144	14.4/14.4 PCMCIA GOLD	\$259.99
XJ1144	14.4/14.4 XJACK	\$229.99
CC3144	14.4/14.4 PCMCIA	\$229.99
XJ196FM	96/96 XJACK	\$179.99
XJ124FM	24/96 XJACK	\$99.99
P2144	14.4/14.4 Pocket	\$239.99

Megahertz

Epson

AP3760	360dpi, 50 sheets, Color Kit optional	\$179.99
LQ570	24 pin, 337cps, Quiet Printer	\$254.99
Stylus 800	180cps, 360dpi, 100 Sheets	\$289.99
Acrolaser 1500	6PPM, 300dpi	\$549.99

Stylus 800

\$289.99



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No matter what kind of graphics or imaging you may want to produce, Ka's Power Tools will immediately accelerate your ability to produce stunning imaging and graphics. Create a limitless range of textures and effects, stunning graphics—fast and easy. The KPT preview windows provide you with real time feedback.

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- PC Fax Modem
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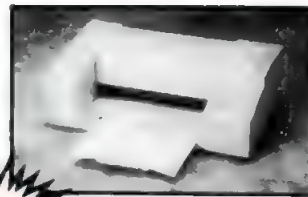
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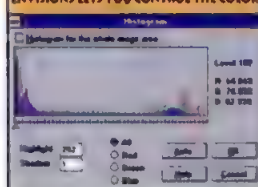
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(Source: PC Computing, April 1994, comparison of the ENV8100 and the HP ScanJet IIcx.)

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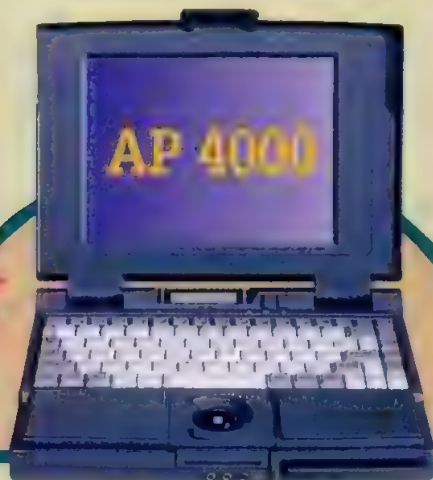
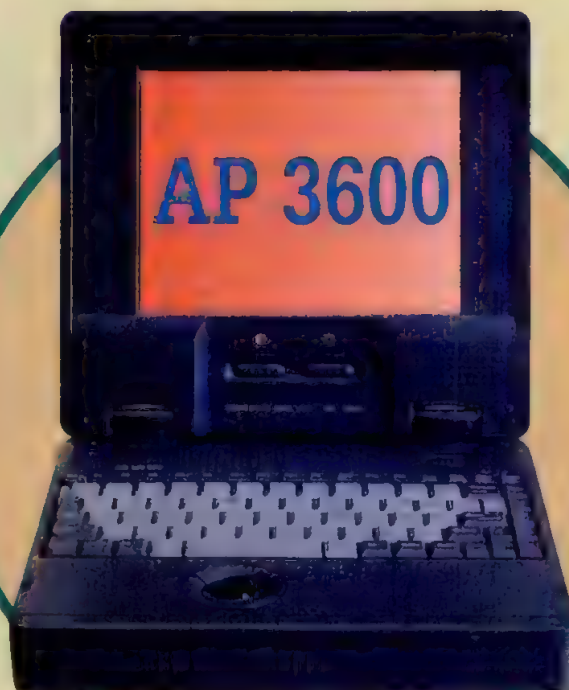
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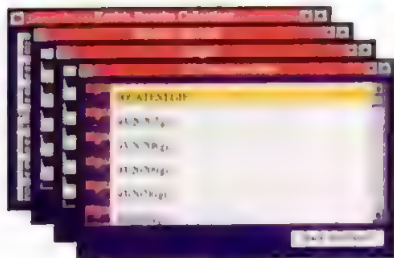
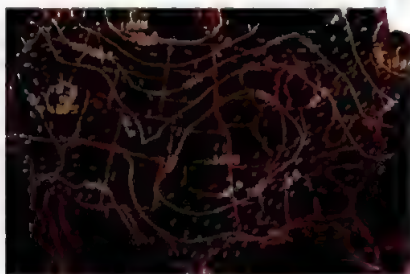
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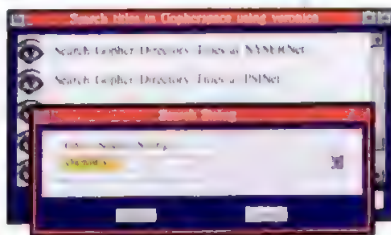


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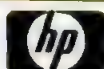
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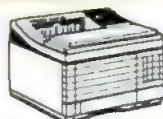
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"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a \$10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

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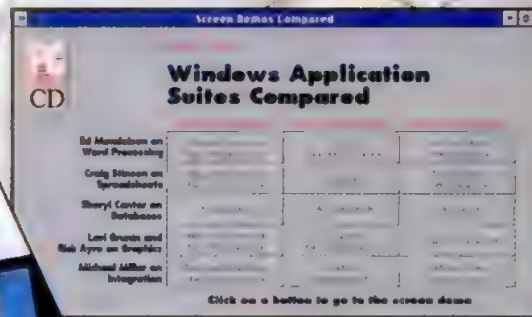
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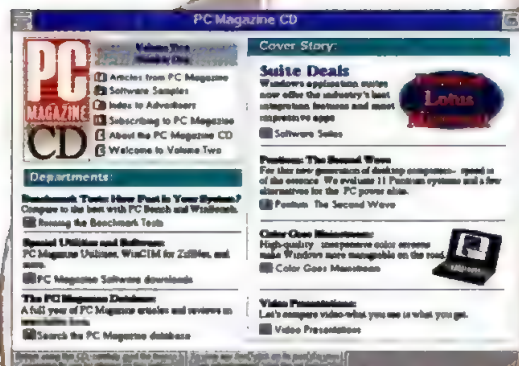


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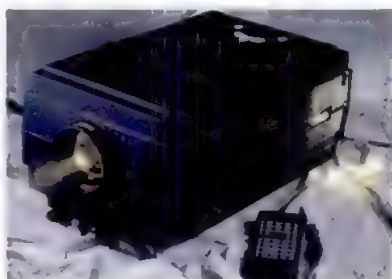


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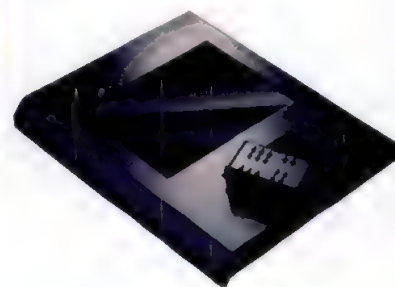
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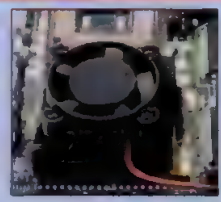


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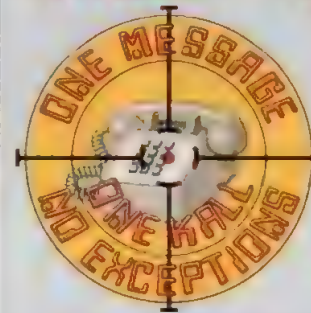


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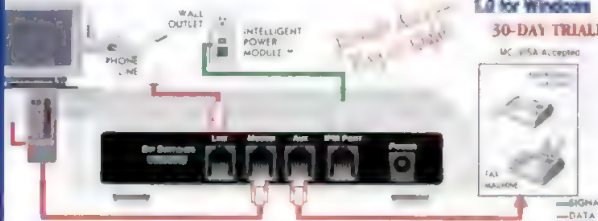
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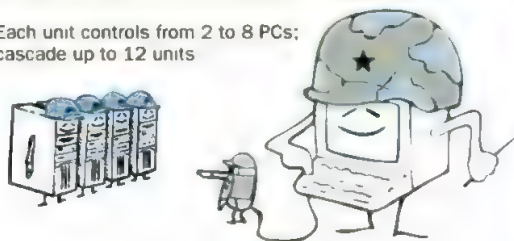


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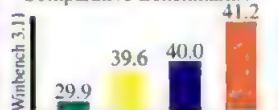


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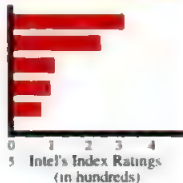
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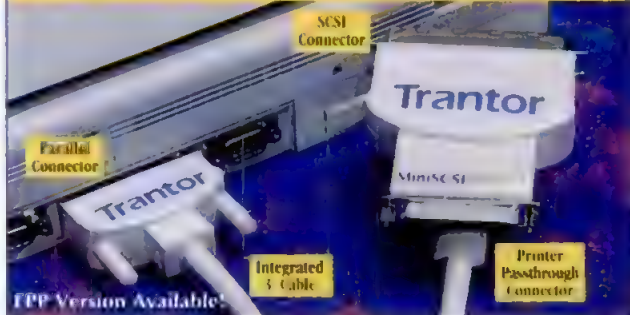
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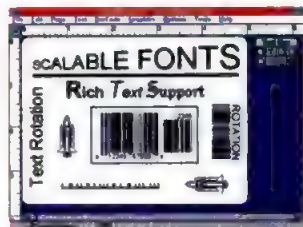
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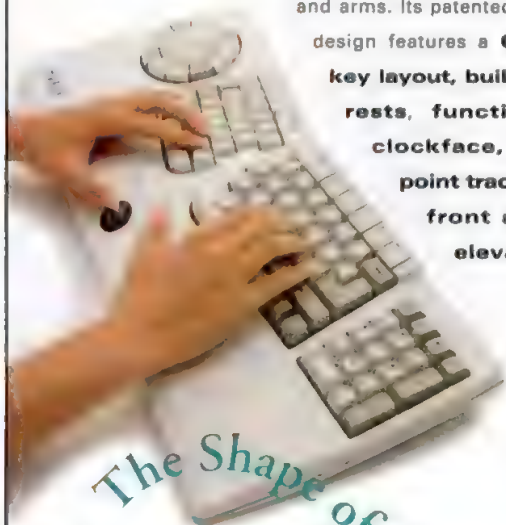
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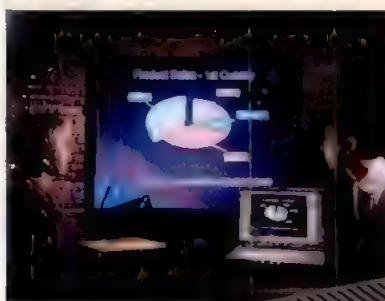


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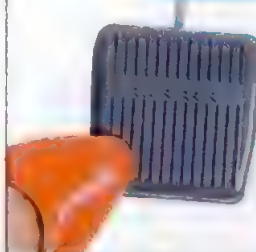
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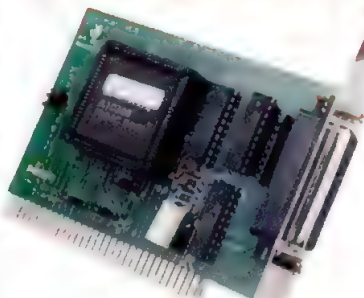
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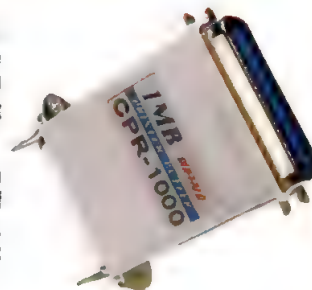
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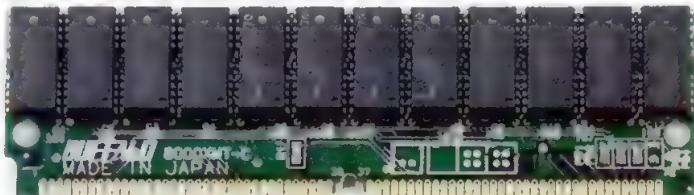


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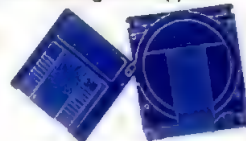
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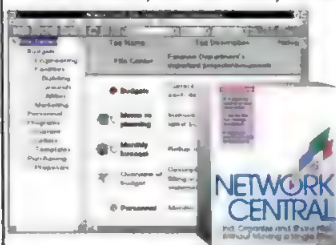
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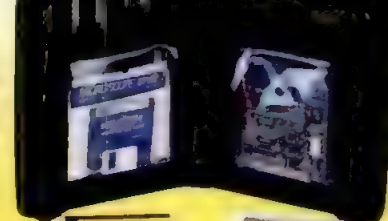
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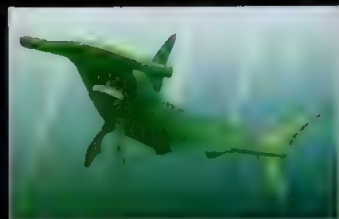
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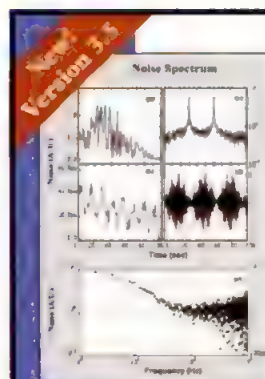
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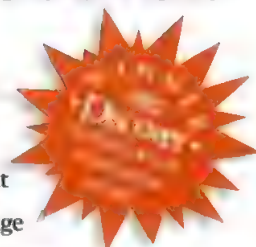
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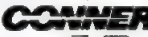
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HP LaserJet 8200	\$144
HP LaserJet 8300	\$144
HP LaserJet 8400	\$144
HP LaserJet 8500	\$144
HP LaserJet 8600	\$144
HP LaserJet 8700	\$144
HP LaserJet 8800	\$144
HP LaserJet 8900	\$144
HP LaserJet 9000	\$144
HP LaserJet 9100	\$144
HP LaserJet 9200	\$144
HP LaserJet 9300	\$144
HP LaserJet 9400	\$144
HP LaserJet 9500	\$144
HP LaserJet 9600	\$144
HP LaserJet 9700	\$144
HP LaserJet 9800	\$144
HP LaserJet 9900	\$144
HP LaserJet 10000	\$144

IBM PS/2 Memory

MODEL	PRICE
IBM PS/2 1MB	\$108
IBM PS/2 2MB	\$144
IBM PS/2 4MB	\$144
IBM PS/2 6MB	\$144
IBM PS/2 8MB	\$144
IBM PS/2 10MB	\$144
IBM PS/2 12MB	\$144
IBM PS/2 14MB	\$144
IBM PS/2 16MB	\$144
IBM PS/2 18MB	\$144
IBM PS/2 20MB	\$144
IBM PS/2 22MB	\$144
IBM PS/2 24MB	\$144
IBM PS/2 26MB	\$144
IBM PS/2 28MB	\$144
IBM PS/2 30MB	\$144
IBM PS/2 32MB	\$144
IBM PS/2 34MB	\$144
IBM PS/2 36MB	\$144
IBM PS/2 38MB	\$144
IBM PS/2 40MB	\$144
IBM PS/2 42MB	\$144
IBM PS/2 44MB	\$144
IBM PS/2 46MB	\$144
IBM PS/2 48MB	\$144
IBM PS/2 50MB	\$144
IBM PS/2 52MB	\$144
IBM PS/2 54MB	\$144
IBM PS/2 56MB	\$144
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IBM PS/2 62MB	\$144
IBM PS/2 64MB	\$144
IBM PS/2 66MB	\$144
IBM PS/2 68MB	\$144
IBM PS/2 70MB	\$144
IBM PS/2 72MB	\$144
IBM PS/2 74MB	\$144
IBM PS/2 76MB	\$144
IBM PS/2 78MB	\$144
IBM PS/2 80MB	\$144
IBM PS/2 82MB	\$144
IBM PS/2 84MB	\$144
IBM PS/2 86MB	\$144
IBM PS/2 88MB	\$144
IBM PS/2 90MB	\$144
IBM PS/2 92MB	\$144
IBM PS/2 94MB	\$144
IBM PS/2 96MB	\$144
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NEVADA 2000	\$144
NEVADA 3000	\$144
NEVADA 4000	\$144
NEVADA 5000	\$144
NEVADA 6000	\$144
NEVADA 7000	\$144
NEVADA 8000	\$144
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NEVADA 12000	\$144
NEVADA 13000	\$144
NEVADA 14000	\$144
NEVADA 15000	\$144
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NEVADA 39000	\$144
NEVADA 40000	\$144
NEVADA 41000	\$144
NEVADA 42000	\$144
NEVADA 43000	\$144
NEVADA 44000	\$144
NEVADA 45000	\$144
NEVADA 46000	\$144
NEVADA 47000	\$144
NEVADA 48000	\$144
NEVADA 49000	\$144
NEVADA 50000	\$144

IBM Laptop Memory

MODEL	PRICE
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IBM Laptop 2MB	\$144
IBM Laptop 4MB	\$144
IBM Laptop 6MB	\$144
IBM Laptop 8MB	\$144
IBM Laptop 10MB	\$144
IBM Laptop 12MB	\$144
IBM Laptop 14MB	\$144
IBM Laptop 16MB	\$144
IBM Laptop 18MB	\$144
IBM Laptop 20MB	\$144
IBM Laptop 22MB	\$144
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IBM Laptop 88MB	\$144
IBM Laptop 90MB	\$144
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IBM Laptop 94MB	\$144
IBM Laptop 96MB	\$144
IBM Laptop 98MB	\$144
IBM Laptop 100MB	\$144

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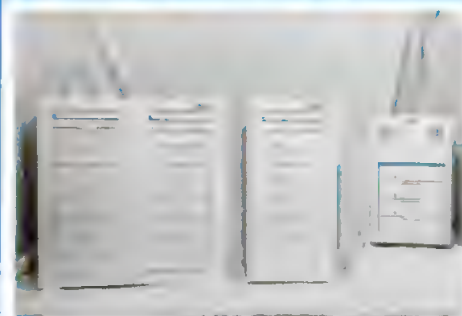
MODEL	PRICE
NEVADA 1000	\$108
NEVADA 2000	\$144
NEVADA 3000	\$144
NEVADA 4000	\$144
NEVADA 5000	\$144
NEVADA 6000	\$144
NEVADA 7000	\$144
NEVADA 8000	\$144
NEVADA 9000	\$144
NEVADA 10000	\$144
NEVADA 11000	\$144
NEVADA 12000	\$144
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NEVADA 44000	\$144
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1.5MEG 4	\$37	\$427	\$444	\$449	\$44
1.5MEG 5		\$154	\$159	\$174	
1.5MEG 6			\$798		
72 P4 30M MODULES					
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1.530 4MEG		\$189	\$174	\$248	
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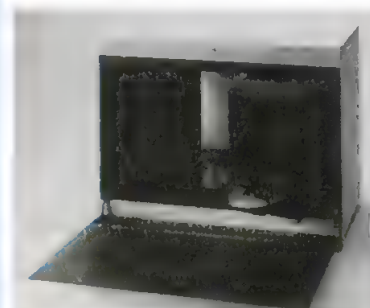
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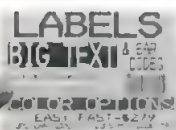
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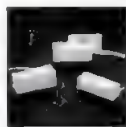
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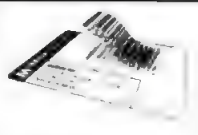
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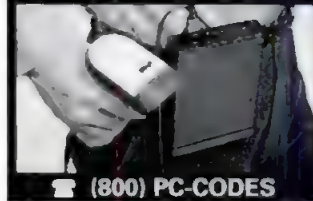
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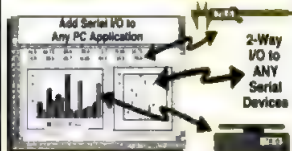
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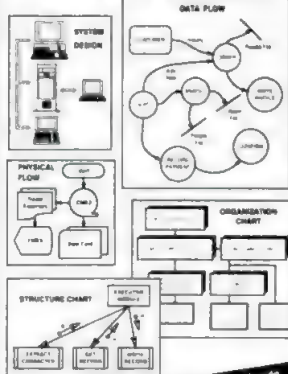
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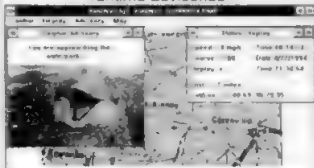
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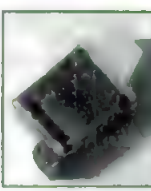
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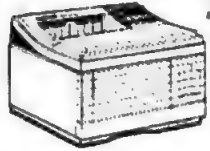
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01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity. (Check one)

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02. ☐ Manufacturer-Aerospace
03. ☐ Manufacturer-Other
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05. ☐ Computer Consultant
06. ☐ Computer Retailer/VAR/VAD Distributor
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4. Is your company a reseller?
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5. For how many IBM PCs and compatibles do you specify brands of products:

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02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

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02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location. (Check all that apply.)

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06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

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Coming Up

The Top 100 CD-ROM Titles

There are thousands of CD-ROM titles available in a wide range of subjects, but many don't use the technology to its full advantage. We rank the best CD-ROM titles in subjects including general reference, productivity, history, science, and entertainment. Find out which ones offer the best content and most innovative use of multimedia.

Fax Software

Long gone are the days when fax packages concentrated simply on automated faxing. The category has seen innumerable changes and innovations since its beginning, and our roundup of DOS- and Windows-based fax software packages highlights the changing scene. Among the major changes are faster engines and more robust feature sets—including binary file transfers, integration of e-mail messages, and auto-forwarding capabilities for faxing on the road. The list goes on, and on. . .

Programmable Databases

Change is in the air as we prepare our yearly wrap-up of programmable, multi-user databases. How do traditional, code-intensive tools compare with the newer, visually oriented systems when it comes to building the apps that really matter? Can a professional system be easy to use and still deliver the goods? Your loyalties are up for grabs as new products from Borland and Microsoft take on the established mainstream.

The Next Wave of Modems

Is your V.32bis modem fast enough, or do you need something faster? Should you wait for V.34-compliant modems to ship, or will this crop fit the bill? PC Magazine Labs put 25 modems through rigorous testing to find the best performers. In this roundup, we look at high-speed modems that run above 14.4 Kbps and offer fax. We also examine related issues—such as voice capability and standards development—and look ahead to see what the V.34 standard will bring.

Digital Image Processing

It shouldn't surprise you to learn that a typical image-processing program uses a variety of algorithms and pixel transformation techniques, but you might be surprised at how simple the algorithms underlying many image-processing effects are. To better understand how this *digital filtering* works, our PC Tutor looks at some of these effects from the bird's-eye view of a professional image-processing program.

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After Hours



EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

☒ DOS ☒ Windows ☒ CD-ROM ☒ Resource-Intensive ☒ Adult Content ☒ Kids (Ages) ☒ Price

Using Your Computer As a Typing Tutor

Whoever coined the phrase "different strokes for different folks" obviously had typing programs in mind. These five programs will all teach you typing skills, measure speed and accuracy, and give you feedback. While some of the packages make learning a game for young students, others take a more straightforward approach, making them better suited to older students.

Expert Typing for Windows

Expert Software, 800-759-2562.

Circle 449 on reader service card

★★★ ☒ ☒ \$14.95

If cost is your primary consideration, take a look at Expert Typing for Windows. This low-cost program will teach you typing while offering a few niceties and extras.

Among other things, Expert Typing for Windows allows you to change screen colors, change the size of on-screen type, and set your own frustration level, which determines the number of characters you must

type incorrectly before the program asks if you want to take a break. One of the extras is the Typing Gallery, a shooting gallery—type game in which you



Young typists find individual letters on Kid Keys' Magic Keyboard.

must type words as they appear on the screen. This may sound easy, but try it when there are three word bands on the screen

and additional words popping up at random!

This one may not offer many bells and whistles, but it's a good low-price choice for older beginning typists.

Kid Keys

Davidson & Associates, 800-556-6141.

Circle 450 on reader service card

★★★★ ☒ ☒ \$49.95

Young children can be intimidated easily by the prospect of typing on a keyboard. To help them overcome this fear, Kid-Keys uses animations, digitized speech, and sound to make keyboarding a fun, nonthreatening experience.

The secret is Keystone the

Dragon, who guides youngsters through three activities:

The Magic Keyboard, Dragon Tunes, and Monster Rescue. In the Magic Keyboard, children can choose to explore the keyboard on their own, or they can choose to find letters and words as prompted by the program.

At the toughest level, they're asked to find the first letter of the word whose picture appears on the screen. The Dragon Tunes exercise enables children to play popular songs by typing letters on the keyboard. The Monster Rescue activity invites children to help free four monsters from the castle and send them home before dark.

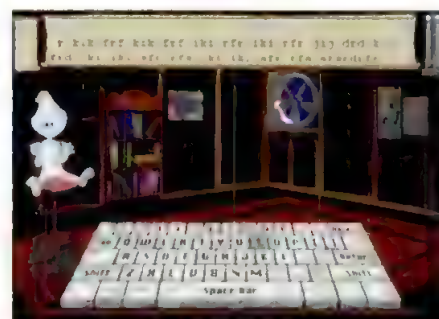
As kids play the tunes and free the monsters, they grow more comfortable with the keyboard and learn how to use it. But don't tell them that; they'll just think they're having fun.

Kid's Typing

Bright Star, 800-757-7707.

Circle 451 on reader service card

★★★★ ☒ ☒ \$49.95



Children practice their typing skills while Spooky, the host of Kid's Typing, looks on.

Your host, tour guide, and playmate for Kid's Typing is Spooky, a friendly ghost who lives in the attic of a suburban home. Spooky teaches you the keys and has you type exercises. When you complete a lesson, he'll take you to another room in the

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house to practice what you've learned. Type Spooky's assignment and you'll haunt the room and cause strange things to happen. In the child's room, for example, you'll make the xylophone play as you type.

After each exercise, Spooky gives you spoken and on-screen feedback on your typing successes; he'll also adapt the lessons to your individual needs. If you want a change of pace, you can go to the Library and practice typing sections from classic stories, such as "The Emperor's New Clothes" and "Cinderella." To practice typing a particular letter, choose a book on the encyclopedia shelf in the Library: Choose the letter A and you'll have to type things such as "Al, an anteater from Arkansas. . . ." The program gives you two on-screen gauges: one for speed, the other for accuracy.



Professor Mario tracks your progress and gives statistics in Mario Teaches Typing.

Spooky's encouragement and sense of humor make typing fun; and his tips on typing (such as keep your feet flat on the floor) will teach good habits, too.

Mario Teaches Typing

Interplay Productions, 714-553-6655.

Circle 452 on reader service card

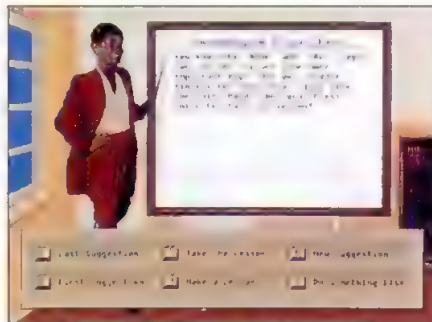
★★★★ \$39.95

Your child says he's practicing his typing, but when you go near the computer, you hear the familiar sound of music from Mario games. Not to worry! Mario Teaches Typing is an ideal way to keep your young gamer interested in

learning to touch-type; it teaches keyboarding while offering the excitement and familiarity of the Mario arcade games.

Sign in to Mario Teaches Typing and choose your alter ego: Mario, Luigi, or The Princess. Next, choose one of the three levels.

In Mario's Smash and Dash, you type the letters that appear on-screen to make your character run and jump, bust bricks, and kick turtle butt. Mario's Wet World Challenge takes you underwater, where you type whole words while trying to avoid the marine creatures. Mario's Tunnel of Doom has you typing full sentences as you navigate a dangerous under-



Mavis Beacon introduces each lesson and explains the goals for the exercise.

ground tunnel filled with falling bricks and quicksand. When you've built your typing speed up to 50 words per minute,

you've completed the program.

A DOS-based CD-ROM version, which should be available by the time you read this, will feature more lessons, as well as a talking Mario who introduces the lessons. And yes, he does speak with an Italian accent.

Mavis Beacon Teaches Typing, Version 3.0

The Software Toolworks, 800-234-3088.

Circle 453 on reader service card

★★★★ \$49.95

Mavis Beacon is the Cadillac of typing programs for older students. It contains all the features you could ever

need—and some you may never have thought of but will be happy to have.

Mavis Beacon interweaves skill practice with a variety of games. To improve your skills, Mavis puts you in the classroom, where she gives instruction and helps you develop your typing expertise.

Mavis wouldn't want you to become dull or bored, so she'll sometimes invite you to join the Traveling Circus and play the Card Flip game (type the right letters, and the people holding cards will turn them over and create a picture that animates), use your keypad to pop balloons, help a clown win the Clown race (the faster you type—accurately—the faster he runs), or practice your rhythm with RoboMan by typing letters as he methodically walks along the track.

Travel Back in Time with Prehistoria

Dinosaurs may get top billing, but prehistoric life on earth offered more than terrible lizards and serious box-office potential. Prehistoria opens a virtual museum and art gallery on your PC. You have the freedom to explore the information in a variety of ways, from tracking prehistoric life on a time line to watching a slide show of fantastic creatures.

CD-ROM PICK HIT



Prehistoria proves that dinosaurs weren't the only creatures roaming the Jurassic world.

The disk's cross-references are astounding. They clarify the links among the creatures, the places they lived, and the periods in which they thrived. Expert commentary, wonderful illustrations, and helpful narration will keep this disk from becoming extinct on your shelf.

—Peter Scisco

Grolier Electronic Publishing, 800-285-4534, 203-797-3530.

Circle 455 on reader service card

★★★★ \$69.95



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Introducing the new Sportster 28,800 bps V. Fast Class modem from U.S. Robotics.

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CIRCLE 888 ON READER SERVICE CARD

After Hours

As you use the package, you're given your scores and error rates. If you do well, Mavis congratulates you; if you make too many mistakes, she lets you know and helps you improve. The program is even able to tailor instruction to your individual needs, allowing you to create your own lessons.

The 79-page user manual alone is worth the price of the software; it includes a history of the typewriter, an overview of the skills Mavis will teach you, practice exercises, and a section dealing with the proper style and formatting of business letters, as well as a description of the artificial intelligence system the software uses to diagnose your individual problems and needs. If you only buy one typing program, it should be Mavis Beacon.

—Charles Taft

Reading

Multilingual Fun on the Farm

Sitting on the Farm

Sanctuary Woods Multimedia Corp., 415-578-6340.

Circle 448 on reader service card

★★★    \$29.95

Not every picnic is ruined by ants. In *Sitting on the Farm*, a parade of unexpected guests turns a little girl's picnic into a multimedia adventure that educates while it entertains.

As with many products for young readers, the core of *Sitting on the Farm* is an animated storybook with text, sound, and pages to turn.

The difference here is that kids



Sitting on the Farm teaches kids reading and writing in three different languages.

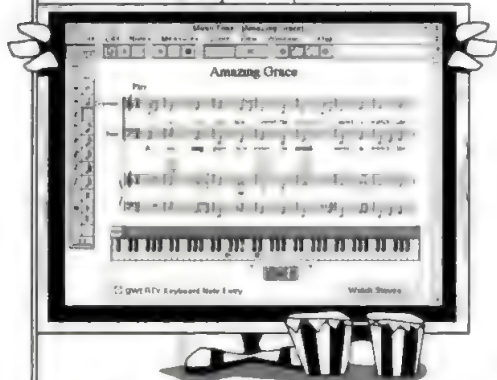
can read along by themselves or choose a male or female reading partner to read the

story aloud in English, French, or Spanish. In addition, they can click on individual words to hear them pronounced or click on the movie camera to watch an animation. And there are hot spots on every page that launch animated events and sound effects when clicked.

Kids can also create a story of their own in the *Write-Along* module. Here, young readers can write a new story to accompany the original illustrations or fill in the blanks to create a story with a different setting. All of these stories can be saved and printed.

Besides helping with reading and vocabulary, *Sitting on the Farm* teaches kids about music through its *Sing-Along* mode. This karaoke option lets kids record themselves singing the story's song and then play the sample back with

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musical accompaniment. Budding mixmasters will enjoy choosing from the many playback options.

The combination of lan-

guage, music exploration, and vividly drawn scenes makes the *Sitting on the Farm* program a real picnic.

—Gayle C. Ehrenman

Adventure

Build It and They Will Come

Ultimate Domain

Software Toolworks, 415-883-3000.

Circle 454 on reader service card

★★  \$59.95

Ultimate Domain is a real-time strategy game of medieval construction, trade, and conquest. Your goal is to

locate and capture seven crystals hidden throughout the 64 provinces of Genesia. A daunting task, even without two adversaries.

You begin with four settlers in an otherwise empty province. Your only hope is to gather or create raw materials so that more houses will attract new settlers. Once your little civilization gets past the basic sur-



Find a way to make your city prosperous and you'll triumph in Ultimate Domain.

QUICK CLIPS

Recommended
? It's Your Call
Not Recommended

Crystal Walls

They call these ho-hum Windows wallpaper animations virtual worlds. We call them virtual bottlenecks. \$49.95; *Domain Virtual Worlds*, 800-896-7537.

? Know Your Waterfowl

If it looks like a duck and quacks like a duck, it must be a CD-ROM field guide to North American waterfowl. It's comprehensive and well organized, but it's also a bit pricey for all but the most avid naturalists. \$69.95; *Axia International Inc.*, 403-262-2942.

Razzle Dazzle 3D

Yup, it's another screen saver. But this one mutates visually in 3-D while it composes original music. Think of it as performance art for your PC. \$49.95; *Road Scholar Software*, 713-266-7623.

Typing for Today

Drills and thrills for those still doomed to hunting and pecking. Lots of easy-to-follow lessons will get your fingers flying in no time. \$29.95; *Interplay Productions Inc.*, 714-553-6655.

vival phase, it's time to think about a more profitable and individualized future. Build a tavern and you can pay its patrons for rumors about the crystals. Build a barracks and you can raise taxes and armies, invade other provinces, and negotiate treaties.

Unfortunately, Ultimate Domain's designers don't play fair. Though you begin with four settlers, computer players receive double that. Your car-

penter requires one turn to produce logs from a single tree; the computer's carpenters saw through three trees per turn.

A mixed rating, then, for Ultimate Domain. Its excellent gaming design and attractive graphics are sabotaged by stacked odds that make computer opponents virtually unbeatable. Playing against other humans is the only way to go.—*Barry Brenensal*

TuneLand

SPOTLIGHT ON MUSIC

Take a trip the whole family will enjoy, with Howie Mandel and his animated alter ego Lil' Howie, who'll escort you through this multimedia musical adventure.

TuneLand offers eight scenes to explore, including a barnyard, a farmhouse, and a train station. In each scene, players point and click to discover animations and songs. There are over 40 songs on the CD, including such preschool favorites as "Bingo" and "This Old Man."

While each click offers its own rewards, which range from tooting train whistles to exploding flowers, the goal is to search each scene to find Lil' Howie and Jack and Jill, as well as the specific character who will transport you to the next scene. Of course, if you get bored in the barn, you can use a hotkey to move on to another location. You may not want to leave some of the scenes, though, until

you've discovered all the sight gags. In the barn, be sure to click on the pail to watch the high-diving frog receive his score from the Olympic judge. Young players who get stuck can call upon the voice of Howie Mandel for spoken instructions and clues.

In addition to the game, TuneLand offers a CD Player that turns your computer into a jukebox for playing the program's songs. There's also an activity book filled with song



lyrics, pages to color, and cutouts of the TuneLand characters. This one is a treat for the whole family.

—Charles Taft

7th Level Inc., 214-437-4858.

Circle 456 on reader service card

★★★★    \$49.95

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott



Happy 10th Anniversary, IBM PC AT

Introduction date: August 1984.
Processor: 6-MHz 80286.
RAM: 512K.
Floppy disk drive: One 1.2 MB.
Hard disk: 20MB.
Monitor: Monochrome.
Price: \$5,795.

Watch where you put those drop caps!!! (MicroTimes.)

Amid all the celebratory hoopla a anal Macintosh team unveiled the years at a company improbably

Wacky Warranty Department

"Your Optional 500-Sheet Paper Tray Assembly is covered under your printer's one year warranty or 90 days, whichever is longer."

—HP LASERJET 4 MANUAL

BY RETROFITTING ITS AKRON SERVICE CENTER, DINKE CORP. TAKES ADVANTAGE OF THE SKILLS OF OUT-OF-WORK LOOMERS.

©RATENANT



Richard Tennant



The Canon BJC-600 is good, but it isn't this good! (Computer Discount Warehouse catalog.)

Novell to buy Microsoft in \$1.4 billion stock deal

By LAWRENCE M. FISHER
New York Times News Service

SAN FRANCISCO — In a two-part deal intended to give it a vast extension of its reach in software, Novell Inc. agreed this week to acquire Wordperfect Corp., in a stock swap valued at \$1.4 billion.

Novell will also purchase Borland International's Quattro Pro spreadsheet

est in applications.

Monday, analysts citing the pending retirement of Raymond J. Noorda, Novell's president and chief executive, with no successor in place, raised question about who would manage the merger.

"This is a conglomeration of product that looks interesting, but there's visionary to pull it all together," Jeffrey Tarter, publisher of Software

Too Late to Classify

"Sincere DWM, MBA, JD, young 53, N/S, 6', in search of SW/AF for ballroom, opera, and travel. Mandarin, FoxPro, Windows a plus."

—THE WASHINGTON POST

"Want to trade WW2 Japanese army rifle for 386 or stronger."

—THE (BEND, OREGON) BULLETIN

"I fix computers and Laser printers on sight. Fast, low rates."

—VENTURA COUNTY STAR-FREE PRESS

A headline from The San Juan Star. Actually, Novell bought WordPerfect. We reckon Microsoft might cost a wee bit more.

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Brian Davis, Charles Hernandez, John Morris, Steve Noll, Tim Saxton, Jim Springfield, and Rosie Wardell.

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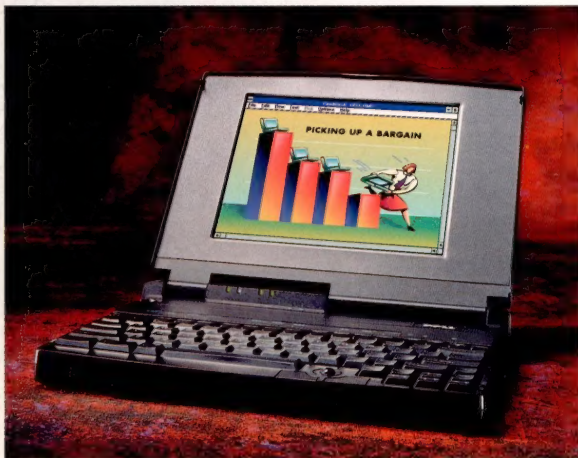
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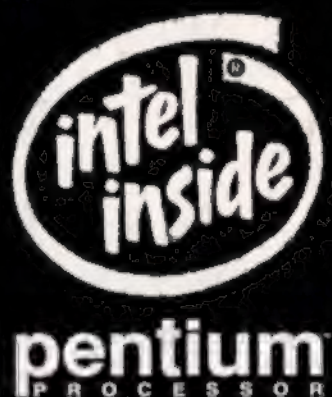
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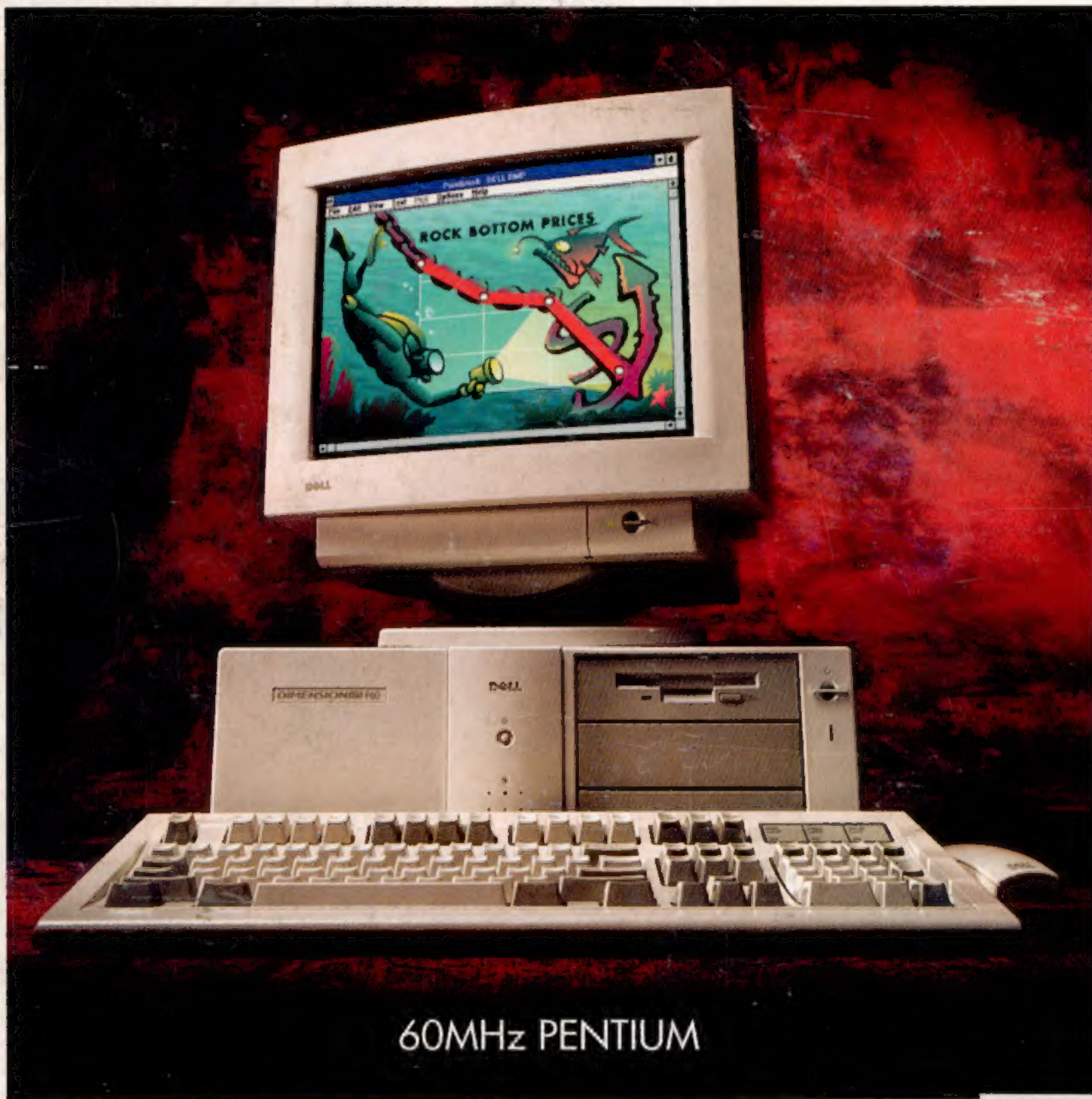
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